The contribution of the informal economy to urban sustainability - case study of waste management in Tepito, Mexico City

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Declaration of ownership

I, Louise Guibrunet, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Abstract

This thesis explores the role of the informal economy in urban environmental management. Cities' relation with the environment is mediated by the urban infrastructure, which provides services such as transport or waste management. Beyond the implementation of plans by local governments, the daily operation of such infrastructure is also the result of informal work. Yet, little is known about the nature and impacts of informal work in urban service provision.

This thesis tackles this research gap by documenting the everyday operation of domestic waste collection and management in a neighbourhood of Mexico City. The aim of this research is twofold. Firstly, it aims to critically analyse the concept of "informality" in the case of urban waste management, and to document how informality operates in that context. Secondly, it assesses the contribution of the informal economy to the waste management system, by contrasting it to the key components of urban sustainability.

The research presents primary data collected through qualitative fieldwork. Using an urban metabolism framework, it documents waste flows through the urban infrastructure, identifying the role of formal and informal waste handlers along the way. In parallel, it explores the normative discourses of informality that are mobilised in the production of Mexico City's urban sustainability policies.

The thesis argues that it is necessary to re-consider the role of informal workers in urban sustainability. In Mexico City, informal and formal waste workers' relationship is symbiotic. Formal waste collection services are sustained by informal work and cash flows. In parallel, informal waste handlers provide the main input (recyclable materials) to the formal recycling industry – this is achieved through the reliance on local solidarity networks and techniques of experimentation and innovation which are characteristic of the informal economy. The informal economy appears to contribute positively to the environmental and social components of urban sustainability. Yet, informal workers are not recognised as legitimate actors in policy making. Instead, the concept of informality is mobilised by civil servants to exclude informal workers from the policy process. This challenges the potential for inclusive governance, a key component of urban sustainability.

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Acronyms

- GHG: Greenhouse gases
- GIS: Geographic Information System
- HDPE: High-density polyethylene
- IIED: International Institute for Environment and Development
- INEGI: Mexico's National Statistics and Geography Institute (Instituto Nacional de Estadísticas y Geografía)
- MFA: Material Flow Analysis
- NGO: Non Governmental Organisation
- PET: Polyethylene terephthalate
- PPP: public-private partnership
- PRI: Institutional Revolutionary Party, a major Mexican political party (Partido Revolucionario Institucional)
- SEDEMA: Mexico City's Ministry of the Environment (Secretaría de MedioAmbiente)
- SOBSE: Mexico City's Ministry of Public Works and Urban Services (Secretaría de Obras y Servicios)
- UN: United Nations
- UNEP: United Nations Environmental Programme
- WIEGO: Women in Informal Employment, Globalising and Organising. WIEGO is a global network focused on securing livelihoods for the working poor, especially women, in the informal economy.

Prologue

Writing about their work peer-reviewing qualitative research studies, Caelli et al. (2003) make a call for a reflection on the researcher's "theoretical positioning" in order to enhance rigour in qualitative research. This positioning, they argue, is shaped by the researcher's individual characteristics (socio-cultural background and experiences) as well as their disciplinary affiliation. Because these affect the researcher's motivations to engage in the research but also shapes the research design, it is essential for the researcher to reflect on those so that the reader can understand better the research approach and the focus of the work.

My interest in the topic presented in this thesis emerged from a practical interrogation. When I was applying for the PhD programme in the Spring of 2013, I was working in a think tank, advising the Mexican government on their urban sustainability policies. One of my frustrations as part of my work was the lack of relevant data at the urban level to inform policy on sustainability. Knowledge on urban processes and how they affected sustainability was always incomplete and seemed inadequate to design policies. In my original PhD research proposal, I therefore proposed the construction of an urban sustainability indicator that would be adequate in the Mexican context. This indicator, I argued, could be used by policy-makers and would help them make informed decisions.

Once I started the PhD and engaged with the literature and explored existing datasets, my point of view changed. I realised the problem was not related to how data is organised, but rather to the object, quantity and quality of the data that is being produced. The datasets I encountered for Mexico City appeared incomplete, inaccurate, and providing only part of the data that was needed to design a sustainability strategy. Most of all, they did not seem to be revealing the complexities of urban life as I experienced it - my anecdotal and personal experiences as a Mexico City resident, and the observation of my neighbours' everyday practices, sometimes felt more insightful than the datasets used by the government. One example of this is informality: I observed informal activities in my daily life, many of which seemed relevant to urban sustainability (such as street vending or informal waste-picking) but these were not represented in any way in governmental datasets. I became interested in how to build datasets which

reflect better the complexities of urban life. This inquiry, which shaped my research, was both a methodological one (how to make better datasets to inform urban sustainability policies?) and a practical one (how do informal processes contribute to urban sustainability?).

The way I approached this topic reflects my educational and professional background: having a Bachelor's degree and a Master's degree from different disciplines (namely political sciences and planning) I do not feel a strong affiliation to a discipline, and have been trained to rely on a range of qualitative and quantitative research methods. In my work as a policy analyst, I was part of a multi-disciplinary team along with engineers, economists, sociologists and biologists. There, I learnt to work across disciplines; particularly, this entailed using research methods from different disciplines and combining them in order to provide answers to complex research questions. In this thesis, this approach is reflected, as a range of research methods from geography, anthropology and urban studies are combined.

In conducting the research presented in this thesis, I learnt about concepts which help me address my methodological enquiry (how to create better datasets for policy making in urban sustainability): for instance, the theory of social constructivism, as well as the practical tools to produce a pluralistic account of material flows, have proved immensely helpful in that regard. In addition, I hope to have shed light on the role of informal workers in handling solid waste in one municipality of Mexico City, which is a start towards understanding better the role of informal processes in urban sustainability more widely.

Chapter 1

Introduction

Sustainable Development Goal 11: "Make cities inclusive, safe, resilient and sustainable."
UN Sustainable Development Summit, New York, 2015

"The major urban challenges of the twenty-first century include the rapid growth of many cities and the decline of others, the expansion of the informal sector, and the role of cities in causing or mitigating climate change. Evidence from around the world suggests that contemporary urban planning has largely failed to address these challenges."
Ban Ki-moon, in the preface to the UN-Habitat (2009) report: *Planning Sustainable Cities*

1.1 Informality and sustainability in contemporary cities

Urbanisation characterises our contemporary society. In 1950, only thirty percent of the global population lived in cities. Since 2008, over half of the world's population is urban (United Nations, Department of Economic and Social Affairs, 2014). This trend is expected to intensify: throughout the 21st century, most of the global population growth will take place in cities, particularly those of Africa and Asia. It is expected that 2.5 billion people will be added to the world's urban population by 2050 (ibid). The United Nations Environmental Programme (UNEP) estimates that sixty percent of the urban infrastructure that will be needed to accommodate the urban population by 2050 remains to be built (UNEP, 2013).

In this context, building a globally sustainable society is a challenge that will play out in cities. Habitat III, a bi-decennial conference organised by the United Nations (UN) and discussing major urban challenges, took place in 2016 in Quito, Ecuador. It focused on achieving a sustainable urban development. Indeed, since the Brundtland Report in 1987 - which put sustainable development on the global agenda[1] - the role of cities in this regard has increasingly

[1] Sustainable development being defined in the report as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987).

been recognised. The output of the Habitat III conference, a document called the "New Urban Agenda", promotes, in line with the Sustainable Development Goal n.11, a vision of cities which are sustainable and inclusive, highlighting the interdependencies between the protection of the environment and the equitable access to resources by all urban dwellers.

Cities play a crucial role in global environmental sustainability (UNEP, 2013); they are extremely resource-hungry and polluting as they concentrate most of the world's production and consumption of goods and services. Although they represent half of the world's population and less than two percent of the global land use;[2] they account for seventy-five percent of CO_2 emissions and overall resource consumption (UNEP, 2013, p.15).

Another battle playing out in cities is that of universal access to basic services (such as water, electricity, education and health services). Cities have never been so unequal (UN-Habitat, 2016), and although the world's wealth accumulates in cities, many urban dwellers still lack access to basic services and remain excluded from socio-economic development. Thus, the challenge of environmental sustainability has to be addressed in parallel to the necessary increase in the provision and universalisation of urban services.

Urban sustainability research has tackled this complex and multi-disciplinary problem in the last decades, and shows the way forward by proposing technologies, building practices, and planning processes to address these challenges. Most prominent examples have been the multitude of eco-friendly settlements planned and built from scratch, whether buildings, neighbourhoods or even cities, of which Masdar City in Abu Dhabi is one of the most ambitious examples. Yet, the challenge of achieving sustainability in existing cities, which requires incremental change in order to take into account the local context and the people already inhabiting the space, is an altogether different one.

The existing city, far from plans and statistics, is built and maintained through formal and informal processes. Informality refers to patterns of spatial organisation, social relations, and economic exchanges emerging outside of government regulatory frameworks, public interventions, and taxation systems (UN-Habitat, 2009, p.133). In the Global South, informality is a defining characteristic of urbanisation, providing access to services for many urban dwellers: for instance, the majority of households of Latin America and the Caribbean address their housing needs outside the formal sector (UN Habitat, 2011, p.ix); relying on techniques such as incremental self-construction and informal financing mechanisms. Alongside houses, urban dwellers may also build and manage their own infrastructure networks. In Karachi, one suc-

[2]Potere et al. (2009) have questioned this figure and argued that urban land could represent as little as 0.5 percent of the earth surface.

cessful example is that of the Orangi Pilot Project, in which urban dwellers, in association with researchers and non-governmental organisations (NGO), successfully experimented in building their own sanitation infrastructure (Hasan, 2002). Other services can be organised at the urban scale: in many cities waste is collected, separated, and transported to the landfill by organisations of informal waste pickers (Wilson et al., 2006), and informal taxi and bus routes are organised for collective journeys (Cervero and Golub, 2007). These activities represent an important share of countries' (and in particularly urban) economies and employment opportunities (Schneider et al., 2010).

Despite the prevalence of the informal city, it is generally overlooked in urban sustainability research and practice. As Ban Ki-moon notes in the preface of the report *Planning Sustainable Cities*, traditional urban planning processes are challenged by the dual concern of informality and environmental sustainability. In the literature, the relation between these two concerns is rarely explored. This research gap has only recently been recognised: in February 2016, the International Institute for Environment and Development (IIED) (along with partners from the green economy and development sectors) organised a workshop called *The biggest 'private sector': what place for the informal economy in green and inclusive growth?*.[3] In the opening keynote, Martha Chen, lecturer in public policy at the Harvard Kennedy School and co-founder and international coordinator of WIEGO (Women in Informal Employment, Globalising and Organising), an organisation documenting the work of informal workers worldwide, stated the following: "supporting the informal economy is an essential pathway to inclusive growth, and is also likely to contribute to green growth - we just don't have enough evidence yet" (Chen, 2016). Chen, along with other speakers throughout the workshop, highlighted how the informal economy, despite its prevalence in the urban system, is generally ignored in sustainability research, leading to a gap as to our understanding of the role of the informal economy in green growth. One key output of this workshop was the call to produce more evidence which could contribute to a better understanding to the relationship between the informal economy and sustainability.

1.2 The case of waste management in Tepito, Mexico City

This thesis proposes to explore the contribution of the informal economy to urban sustainability by taking a case-study approach. The case is that of the everyday operation of domestic waste collection and management in a neighbourhood of Mexico City called Tepito.

[3]Details of the workshop can be found on the IIED website. See: `https://www.iied.org/biggest-private-sector-what-place-for-informal-economy-green-inclusive-growth`

The role of the informal sector in urban waste management has been thoroughly documented (see for instance the work by Wilson et al. (2006, 2009)). Mexico is no exception: academic research has documented the role of informal workers in collecting, transporting, processing and disposing of waste alongside formal waste management systems (Medina, 2005; Castillo Berthier, 1984). Yet, this has not led to further research on the role of this informal work in furthering (or, perhaps, in hindering) urban sustainability. In official documents dealing with Mexico City's waste management, the existence of an informal sector (let alone its contribution to sustainability) remains invisible. The thesis explores the reasons for this invisibility - which are at times technical (that is to say, the exclusion of the informal economy from environmental research can be explained by the technical limitations of the research methods used - which are not adequate to document informality); and at times political (the exclusion is produced through decisions taken by civil servants and policy makers).

Mexico City is a megacity of over twenty million inhabitants, where waste collection is managed at the municipal level. Documenting the complex role of informal workers in the waste management system has to take place at a scale where the system is provided relatively homogeneously; therefore, I have chosen the neighbourhood as the unit of analysis. The neighbourhood chosen to conduct the empirical work is Tepito, a small ($1km^2$) neighbourhood nearby the historic city centre. It is a low-income, pre-hispanic neighbourhood populated over the years by national migrants. Tepito is a neighbourhood which epitomises urban informality: historically, poor urban dwellers have arrived in Tepito because they knew they would find a job and housing (albeit informal). As such, they have rarely relied on the government for support. This may explain why over time, residents organised to regulate the daily life in the neighbourhood: in some of Tepito's streets, taxes are paid to informal leaders rather than the state, who are in charge of providing urban services (from policing, to waste management, citizens' advice, working permits, health services, among others). This predominance of local, bottom-up organisation and the resulting informal provision of urban services makes Tepito an excellent case to explore the role of informal work in waste collection and management.

1.3 Research aim, research question and definition of key terms

This thesis aims to contribute to a better understanding of the synergies and tensions between informality and sustainability in an urban context. It takes a case-study approach, and therefore documents the contribution of the informal economy to urban sustainability in one particular case, that of waste management in a neighbourhood of Mexico City. In order to do so, it is necessary to address the research gaps as to the diversity of waste handlers in urban Mexico,

and of their contribution to waste management. How do they participate in waste management? How do they interact with formal waste handlers (that is to say, the garbage-men)? How are they integrated in the governance system?

The research question is the following: *What is the contribution of the informal economy to waste management - and its sustainability impacts - in the neighbourhood of Tepito?*

Three sub-questions structure the analysis:

1. How does waste flow through the neighbourhood of Tepito?
2. Which socio- political and physical factors organise these waste flows?
3. What are the consequence of these waste flows for urban sustainability?

The key terms of the research question are defined as follows. These definitions will be justified and refined in Chapter 2.

"informal economy": informality refers to patterns of spatial organisation, social relations, and economic exchanges emerging outside of government regulatory frameworks, public interventions, and taxation systems (UN-Habitat, 2009, p.133). An "economy" is "the system of trade and industry by which the wealth of a country is made and used" (Cambridge Online Dictionary, 2016); simply put, the economy refers to productive activities which generate wealth. In this thesis, the "informal economy" refers to productive activities (including the labour, capital and resulting economic exchanges) which emerge outside of government regulatory frameworks. This regulatory framework includes the taxation system, but also the body of environmental regulations which applies to the private sector. Informality is the central concept of this thesis, yet it is one that is contested and defined in multiple ways. The adequacy of this preliminary definition of the informal economy is discussed throughout the thesis, and the Discussion chapter proposes a conceptualisation of the informal economy which builds on the debates presented in the review of the literature and reflects the findings of the empirical chapters.

"waste management": these are the activities related to the collection, transport, processing and disposal of waste. This thesis only looks at the management of the domestic (that is to say, that of households and small businesses) solid waste produced in the neighbourhood of Tepito.

"urban sustainability": another contested concept, the definition of sustainability is discussed in detail in Section 2.2.2. Simply put, urban sustainability is defined as the processes through which the city contributes to the global sustainable development agenda (Rydin, 2010). Sustainable development refers to "development that meets the needs of the present without compromising the ability of future generations to meet their own needs", as defined in the report

Our Common Future, generally known as the Brundtland report (World Commission on Environment and Development, 1987).

1.4 Key argument of the thesis

The thesis argues that it is necessary to acknowledge and document the role of informal workers in urban sustainability. The informal economy appears to play a key role in urban waste management. Its role is diverse (through the work of street sweepers, waste-pickers and recycling traders) and is instrumental in building up the city's recycling chain: informal waste handlers thus sustain the formal recycling industry by providing its most basic input (recyclable materials). Through this work, informal workers contribute to environmental and social aspects of the city's sustainability. In addition, informal and formal waste handlers work in a symbiotic way and their waste collection activities are interdependent: the formal infrastructure and waste collection services are sustained by informal work and informal cash flows. Yet, the contribution of the informal economy to the waste management system remains undocumented. In official documents, the existence of such an informal economy is not acknowledged. Neither the working conditions of informal workers (and particularly adverse health impacts of working with waste), nor their potential role in a waste management strategy, are taken into account in policy-making. This thesis argues that policy-makers need to take informal practices into account, not only because informal workers' lives are directly affected by sustainability policies, but also because they hold the experiential knowledge, networks and a culture of innovation which play a key role in making their city more just and sustainable.

The contribution of this thesis is also methodological.

The thesis proposes a methodological framework based on urban metabolism, which is the study of the production, use, transformation and disposal of natural resources in cities (Kennedy and Hoornweg, 2012). The framework is adapted so that it explicitly engages with the informal city. Making use of both quantitative and qualitative data collection, it aims to produce a pluralistic account of environmental flows taking into account the experiences of all stakeholders. The conclusion of this thesis reflects on the usefulness of such a framework, and argues that because it documents people's relation to environmental flows in a qualitative way, this framework allows for an engagement with concerns of environmental justice and resource efficiency; and is therefore adequate to address urban sustainability.

1.5 Outline of the thesis

Chapter 2 explores the existing literature on the role of the informal economy in urban sustainability. Looking particularly at the case of waste management, it argues that although the

topic of informality has been touched upon, a thorough assessment of its role in furthering sustainability is still lacking. Different historical and disciplinary approaches to the informal economy are reviewed and contrasted in terms of their explaining power in the case of waste management. The chapter then discusses the definition of urban sustainability, arguing that it necessarily includes the question of equity; this informs the thesis's focus on the recognition of informal waste handlers' work. The last concept is urban metabolism, which frames the methodological approach to the research. The method of Material Flows Analysis (MFA), used within the field of industrial ecology, is presented; and it is suggested that if MFA is to be useful for urban sustainability research, it needs to be politicised in order to take marginalised groups into account.

Chapter 3 presents and contextualises the case. In Mexico City, there is a discrepancy between official knowledge and the realities of waste management, particularly with regard to the work of informal waste handlers. On the one hand, the official databases on waste management do not recognise the existence of informal waste workers, nor their role in managing waste. On the other hand, the anthropology literature reveals the existence of these informal workers, and their work alongside formal workers. Tepito is presented as a quintessentially informal neighbourhood, due to its economic activities (mainly informal street markets) and its governance system (through informal street associations). This implies a high reliance on informal workers for service provision throughout the neighbourhood. Because of this, Tepito makes an excellent case to learn more about the role of informal workers in urban waste management.

Chapter 4 presents the methodology used in this research. The research questions and objectives are introduced, followed by a discussion of research epistemology. The grounding of the research in social constructivism is justified by presenting waste as a social object, which implies that waste management is shaped by people's perceptions of waste. The data collection and analysis methods are presented: they are based on the method of MFA, adapting it in order to produce a pluralistic account of waste management, that is to say, to document the multiple perspectives of local waste workers. Primary data collection is crucial, and is conducted by using MFA as a data-gathering tool and by combining observations, interviews and surveys. The chapter ends with a reflection on positionality, that is to say, the role of the researcher in shaping the research, with a particular emphasis on the relationships established with the research participants.

Chapter 5, the first empirical chapter, looks at waste governance through a discourse analysis of civil servants' perspectives on informality and sustainability. The purpose of this chapter is to explore the portrayal of informality by policy-makers, and their view as to the compatibil-

ity of informality with urban sustainability. Various discourses are identified, which show how civil servants mobilise different interpretations and visions of informality when constructing arguments about the city and its sustainability. One discourse, most used by civil servants in charge of waste management policy and operation in Mexico City, portrays the informal economy as exploitative, evading taxes and regulations, autocratic, and generally ungovernable. This description put forward by civil servants shows informal work as being incompatible with a developed, democratic society; and it is as such a barrier to achieving (civil servants' vision of) urban sustainability. In turn, the potential role of informal workers in urban environmental management is systematically dismissed. This enables a reproduction of power imbalance within which the government's vision is dominant and strengthened, while informal workers are maintained in a state of marginalisation, with no recognition of their work. Urban waste management strategies are shaped by this dominant discourse and promote a techno-centric vision of sustainability while failing to challenge the invisibility and unfair treatment of informal waste workers.

This vision of informality as being irrelevant to waste management (or peripheral to it) is challenged by the presentation of three vignettes, which act as a transition between Chapters 5 and 6. The vignettes relate selected stories of waste flows through Tepito. By presenting the empirical material in a descriptive narrative, these serve as an introduction to the following two empirical chapters, which both document informal waste management through primary data collection at the neighbourhood scale.

Chapter 6 documents the flows of Tepito's waste metabolism, and demonstrates that informal work is not only an integral part of waste management, it appears to actively sustain the formal waste management system. The municipal waste collection team relies on informal workers to do their job (from street sweeping, to helping the municipal crew and collecting recyclables on the collection route). In parallel, the collection and processing of recyclable materials is handled exclusively in the informal economy by a range of waste handlers. Their activities provide a constant stream of recyclable material to the formal, multi-national recycling industry. The action of these informal waste handlers is not negligible: quantitative results show that in the neighbourhood of Tepito, the biggest diversion from landfill is achieved through recycling, which is almost exclusively handled informally.

Chapter 7 qualitatively explores informal workers' daily practices, thus revealing the ways in which the informal recyclables chain is organised. Particularly, it is based on solidarity networks within which different actors engage in waste separation in order to help destitute waste-pickers. Thus, engaging in waste-picking cannot only be explained by the necessity to

earn money, but rather as a community activity through which wealth can be redistributed to those who most need it. Another aspect of the recyclables chain is its dependence on experiential knowledge. By working on an everyday basis within the same neighbourhood, informal workers gain knowledge of how to best extract recyclable materials from domestic waste. This knowledge is exchanged and strengthened within the local networks of waste handlers.

Chapter 8 discusses and makes explicit the findings of the thesis. Drawing from the three empirical chapters, it reflects on the main themes identified and how they relate to the existing literature. It starts by taking a critical look at the concept of informality, and proposes that rather than being a parallel economy to the formal one, the informal economy is the sum of those activities which *sustain* formal systems. It then highlights the impacts of the informal waste economy on the Tepito's waste management system and the city's sustainability: by achieving diversion from landfill and creating durable and accessible livelihoods for the urban poor, informal waste handling contributes positively to social and environmental aspects of sustainability. Yet, informal workers remain excluded from the decision-making process, which challenges the good governance component of urban sustainability; and as a result poses the question of the interdependency between urban sustainability and environmental justice.

Chapter 9 is the final chapter of this thesis. It starts by summarising the research findings (answering the three research sub-questions in turn), and points out two key implications of the thesis, in terms of the inclusion of informal workers in waste management research and policy, and with regards to the consideration of everyday practices in sustainability research. Finally, it ends with opening avenues for further research.

Chapter 2

The contribution of the informal economy to urban waste management and sustainability

The challenge of this chapter is to bring together bodies of literature from different disciplines: informality, sustainability and waste management (the key themes of this thesis) have been thoroughly researched in urban planning, geography, development studies, sociology, engineering or anthropology. Yet, very few of these disciplines have explored the relationship between informality and sustainability in the context of urban waste management. Although there is now evidence that informality has a role to play in urban environmental management (UN-Habitat, 2009), there is still a gap as to how to include the informal city in research and policy making for urban sustainability. This chapter first draws on two research debates (the role of informality in urban environmental management, and informal waste management) in order to identify the research gap, and then introduces the theories and concepts (sustainability, informality and urban metabolism) used to frame this research. Particularly, the concept of urban metabolism is presented as an adequate one to address the research gap - provided it is used in a critical way.

2.1 Research problem: the role of the informal economy in urban sustainability

This section identifies a research gap by exploring two related bodies of literatures. The first one is that of urban environmental management, more specifically the role of the informal economy in managing the urban infrastructure and providing urban services. The second is that of waste management, within which the role of informal workers is explored.

2.1.1 The role of the informal economy in urban environmental management

In a context where most of contemporary urbanisation occurs informally (UN Habitat, 2011, p.1), there is evidence that informal work (defined as taking place within an informal economy) plays a key role in urban infrastructure management and the delivery of urban services (Hyman,

2013; UN Habitat, 2011; Revell, 2010). Informal and formal service provision coexist, although the scale of informal service provision varies across cities. Seminal studies have shown the role of the informal economy in providing services such as public transport (Cervero and Golub, 2007), waste management (Wilson et al., 2006), sanitation (Hasan, 2006) or housing (UN-Habitat, 2003).

Although the urban poor's main motivation for engaging in economic activities which are related to infrastructure and service provision is arguably one of survival and providing for their own needs, Simone has argued that the impacts of urban dwellers through self-provision extend well beyond their daily survival; they participate in shaping the city and its development (Simone, 2008). In Simone's view, the city is built by the people who dwell in it, and therefore it is necessary to look at daily practices and modes of dwelling to understand how the city works. Indeed, this point extends beyond informal groups only, and it is the dynamism of diverse urban groups which maximises the potential of the city to develop. Particularly, through their practices and interaction with objects, spaces, and persons, urban dwellers make up the infrastructure of the city - by "providing for and reproducing [urban] life" (Simone, 2004, p.408). Thus, urban infrastructures are more than technical constructions, particularly in urban contexts:

"Cities are the densest expression of infrastructure, working to provide us with shelter, energy, food, water. The infrastructure consists of structures: roads, pipes, bridges, railways, etc but also the "software" which is the sum of formal and informal rules for the operation of the systems" (Ausubel and Herman, 1988).

Besides the physical infrastructure (roads, and pipes) and the software (the rules of the games) identified by Ausubel and Herman, there is also a social component to infrastructure, as infrastructures are produced and maintained through human labour. "Infrastructure" can thus be defined as a socio-technical system at the interface between society and nature, and encompassing the networks, systems and practices that result in the consumption and transformation of natural resources.

Urban energy and resource consumption is closely related to the physical infrastructure (public transport, sewage systems or energy distribution systems for instance); this can explain why improving infrastructure networks has been identified as a key opportunity in addressing environmental challenges (UNEP, 2013). In addition to these environmental impacts, infrastructure also shapes social aspects of urban life: Graham and Marvin (2001) have shown that infrastructure design and management determines access to natural resources and urban services (land, water, sanitation, transport services among others) and thus shapes patterns of equity and exclusion. In this sense infrastructure planning holds the fundamental potential to make the

city democratic, competitive, socially just and ecologically efficient (Swilling, 2011; Graham and Marvin, 2001; Guy et al., 2011). Monstadt (2009) summarises these arguments and argues that because infrastructure networks are the interface between society and nature that reifies the metabolisation process, these networks are the key object of study in sustainability. Along similar lines, Hyman (2013) points to urban infrastructure as a valuable "intervention point" to achieve urban sustainability.

Informality is part of how cities function; therefore, the co-dependency between informal processes and urban sustainability ought to be well researched. This is particularly crucial as the informal economy plays a role in maintaining urban infrastructure and the provision of services. Yet, research on urban material flows has hardly accounted for informal processes - and their interaction with infrastructure management - in the urban system. One reason for this is the lack of readily available quantitative data on informal processes, which prevents their integration into material flows research (Fernández, 2014; Currie et al., 2015; Hoekman and von Blottnitz, 2016). Despite those challenges of integrating informal processes in environmental research, there has been recent interest in the potential role of the informal economy in a sustainability transition.

A report by the IIED studies the potential contribution of various economic sectors (waste management, agrifood markets, artisanal mining, energy delivery, housing, infrastructure and food) to greening the economy, and explores the duality of the informal economy: on the one hand, it is generally associated with poor working conditions and degradation of the environment, yet on the other hand they are also drivers of innovation and social inclusion. They provide livelihoods to many people - people who hold experiential knowledge on their local environment which can play a key role in a transition towards a green economy. Thus, the report concludes that informal economies have the potential to "drive the transition to greener economies," particularly in the context of the Global South (Benson, 2014, p.5).

A related IIED report argues that the informal economy is a driving force of urban economies. Thus, it has to be understood and taken into account in the transition to resilient and sustainable economies - because it will play a role in such a transition. Thus, more research is needed, beyond the dogmatic debate about formalisation, to understand which sectors of the informal economy already contribute to this transition, and how they can best be supported Brown et al. (2014). Building on this topic, Brown and McGranahan (2016) propose key policy actions to support a green transition within the informal economy, including a softening and simplification of environmental regulations, a collaboration with informal workers (such as waste-pickers) to co-produce green outcomes, as well as an encouragement and protection of

informal economies which already contribute to a green economy. What is necessary, this paper concludes, is to apply the principles of inclusive urban planning to the informal city, in order to drive a transition to a green economy which is also inclusive of all urban dwellers (including informal groups):

"Thus, from a planning perspective, the urban informal economy needs to be both recognised and incorporated in a manner that gives full recognition to the rights of the people who depend on this economy for their livelihoods. The application of more pro-poor urban planning and collective action, such as that discussed above, could be an important first step toward economies that are not only greener, but also more inclusive." (Brown and McGranahan, 2016, p.103)

What these researchers call for is thus an inclusion of informal workers in knowledge production, decision making and planning processes. This argument is a normative one, based on the idea that actors that contribute to environmental management deserve to be integrated in the decision-making process. The next section turns to a body of literature which has, to some extent, integrated considerations of informality and sustainability - it is that of urban waste management.

2.1.2 The role of informal workers in urban waste management

The management of domestic solid waste has implications for all aspects of urban sustainability (UN-Habitat, 2010). In cities where waste collection rates are low, improving the waste management system is first and foremost a public health imperative. Additionally, waste that is not processed properly has negative environmental impacts (such as greenhouse gas emissions or production of toxic by-products). Waste management poses an economic challenge for local authorities, being one of the highest expenditures of municipalities in low-income countries (UN-Habitat, 2010; Le Courtois, 2012). On the other hand, it provides a livelihood to marginalised urban dwellers (who have no other access to work, because of low education levels, drug addiction, or age); up to five percent of all urban employment is estimated to relate to waste management activities (Hoornweg and Bhada-Tata, 2012).

Urban waste is managed by a range of intermediaries which can be characterised alongside a continuous spectrum of formal and informal practices. In many cities, waste is managed partly by informal groups working independently of government planning and monitoring systems (Wilson et al., 2006). The literature documents the existence of informal street sweepers, household waste-collectors, helpers to the municipal collection crew, and waste-pickers in the streets and on the landfills who collect, process, transport and trade waste alongside workers from the public and private sector (Medina, 2000, 2005; van Beukering, 1994; Wilson et al.,

2012). The informal sector, integrated by a myriad of independent workers and family businesses who engage in waste management as a subsistence activity, is most often understood at lying "out of state control" (Ezeah et al., 2013, p.2510).

Research on these activities has documented the working conditions and livelihoods of informal waste-pickers, often characterised by exploitation, poverty and risks to workers' health (see for instance: Beall (1997); Castillo Berthier (1984); Hunt (1996); Huysman (1994); Moreno-Sanchez and Higinio Maldonado (2006)). In parallel, recent assessments have examined the contribution of informal workers to urban waste management systems, and the associated environmental impacts (Benson, 2014; Ezeah et al., 2013; Vergara et al., 2015; Wilson et al., 2009). Localised quantified studies in Bogota (Vergara et al., 2015) and Bali (Bruce and Storey, 2010) show that informal waste management systems are more efficient than their formal counterpart by being cheaper systems and producing less greenhouse gas (GHG) emissions. Looking at the case of e-waste, Streicher-Porte et al. (2005) have suggested that informal recuperation, reparation/refurbishing/upgrading, as well as recycling activities have a key impact on the lifespan of personal computers in Delhi, which suggests that informal waste recovery contributes to urban resource efficiency.

In a review of formal and informal waste management in six cities and four continents (Cairo in Egypt, Cluj-Napoca in Romania, Lima in Peru, Lusaka in Zambia, Pune in India, and Quezon City in the Philippines), a research team identified the informal sector as being more efficient than the formal sector in terms of waste recovery (CWG, 2010). Particularly, the informal sector tends to achieve a higher amount of waste recovery, doing so at a lower cost and with a lower carbon footprint. This is for various reasons: informal workers use labour rather than machinery, have a more flexible waste-collection system, and separate waste at the source (thus eliminating transport costs and reducing the contamination of recyclables). A modelling exercise showed that eliminating the informal waste management activities would be detrimental economically and environmentally for the municipalities concerned, while a strategy based on acknowledging informal workers and cooperating with them would be a way to increase the overall efficiency of waste management (ibid.).

Beyond comparing formal and informal systems, one key finding of the literature, consistent throughout the Global South, is the dependence of the formal urban waste management systems on a variety of informal components. Firstly, there is evidence of informal recyclers providing essential inputs (in the shape of raw material) to formal industries (Chi et al., 2011; Streicher-Porte et al., 2005; Wilson et al., 2009). For instance, in their analysis of an e-waste recycling hub in Accra, Ghana, Grant and Oteng-Ababio (2012) explain that government-

recognised businesses depend on informal workers through outsourcing and subcontracting. They also receive their main input, selected e-waste, from informal workers. The wide diversity of informal waste work (buying, selecting, gathering, processing, disassembling e-waste) is thus central to this urban e-waste economy in a process that the authors refer to as "normalisation of informality" (Grant and Oteng-Ababio, 2012, p.18). Similar observations about the close interactions between the putatively separated formal and informal waste management sectors have been made in other contexts, such as China (Chi et al., 2011), Vietnam (Kawai et al., 2012), and Mexico (Frykman, 2006; Hilburn, 2015). The informal sector may also play a role in improving and extending the coverage of waste collection services: in the case of urban Mexico, *cartoneros* collect domestic refuse where municipal collection is lacking (Medina, 2005). This is particularly common in informal settlements where households do not pay local taxes or in municipalities with low financial capacities. Independent workers, using pushcarts or trolleys, collect domestic waste from households for a small fee. They then dispose of it in sanitary landfills or local municipal transfer stations. Medina suggests that, in this way, informal workers complement the work of municipal collection crews, particularly in those neighbourhoods where the municipal service cannot be provided.

These empirical findings inform Scheinberg et al.'s analysis, which characterises waste management services as an arrangement of "modernised mixtures" of high-tech, centralised models of infrastructure management coexisting alongside small-scale, decentralised ones. The authors identify this mixture as a factor in their efficiency:

"When delivery systems for sanitation, water, energy and cleansing services in Africa, Asia and Latin America function well, they often consist of a kind of patchwork set of initiatives of public, private and NGO actors which look surprisingly like the modernised mixtures now emerging in Europe." (Scheinberg et al., 2011, p.190)

The authors suggest that in Europe, modernised mixtures have appeared within the context of ecological modernisation and actively support the development of efficient waste management systems. Thus, policies for modernising or improving waste management systems should not try to copy western models of the previous century (that is, only importing large-scale, centralised systems) but rather to capitalise on the modernised mixture, which appears as a key aspect of the system's sustainability and resilience.

Private and informal actors are a force to be reckoned with in waste management systems, although the size and manner of their contribution depend on the context in which they operate. In this light, the recognition of informal workers and the improvement of their working conditions become a crucial point to address. Most authors establish a link between the well-

being of informal workers and the role that they play in facilitating the recycling and reuse of waste, hence improving the environmental health of the whole city (Ahmed and Ali, 2004; Chi et al., 2011; Ezeah et al., 2013; Medina, 2000; Rouse, 2006; Wilson et al., 2009). Yet, despite the evidence, policy makers tend to perceive informal workers as a negative influence in the waste management system (see Medina (2000); Sembiring and Nitivattananon (2010); Nzeadibe (2009)), and the inclusion of informal workers in waste management policies remains rare (Wilson et al., 2012).

2.1.3 Formulation of a research topic

The role of informal practices in urban sustainability appears as a gap in the literature. Although informal workers participate in infrastructure provision (a key aspect of urban sustainability), very little is known as to their contribution to such urban sustainability. This is at least partly due to the research focus of traditional urban sustainability research, which is generally determined by the availability of datasets (and as has been deplored by Fernández (2014); Currie et al. (2015); Hoekman and von Blottnitz (2016)). What characterises the urban informal economy is that transactions, processes and flows are not reported in government datasets as they are not recognised as legitimate; this limits its integration in sustainability research.

The following questions remain unanswered: How does the informal economy manage urban infrastructure? What is its role in the urban system? How does it contribute to urban sustainability? And this leads to wider questions and debates: How to frame and understand the role of informal practices in the city? How to study informal practices? The waste management literature presents an entry point to answering these questions through documenting the role of informal workers in urban waste management.

I suggest that insights from research on waste management may help inform wider debates of the role of informal workers in urban environmental management, and in turn in urban sustainability. Yet, one weakness of the existing waste management literature is that it takes the concept of informality for granted, and does not provide a critical assessment of it. In addition, the literature tends to address particular aspects of sustainability (such as environmental impacts of waste management, or its public health impacts) rather than engaging with urban sustainability as a multi-layered issue. Assessing the contribution of the informal economy to urban sustainability necessarily depends on how these two concepts are defined. The next section thus turns to a critical discussion of how these terms can be defined, and justifies the use of a definition for this research. Then, it proposes urban metabolism as a framework to address the research gap.

2.2 Theoretical framework

This section turns to three theoretical concepts that are used to address the research gap identified. The first two, the informal economy and urban sustainability, are contested concepts: they have been defined in widely different ways in different academic disciplines. This section presents a reflection on how these central concepts have been conceptualised in academia and policy, and justifies the definition that is adopted for this thesis.

2.2.1 Conceptualising the informal economy

How has informality been studied in an urban context? The term "informality" appeared in the literature in the early 1970s (Hart, 1973; Bangasser, 2000) in the context of African cities, as a way to characterise a growing proportion of precarious urban employment that did not correspond to existing employment typologies. Studying this phenomenon, Hart suggested that despite being invisible in official statistics, informal workers could possibly "supply many of the essential services on which life in the city is dependent" (Hart, 1973, p.68). Based on these observations, he urged for the development of a new typology of employment types, taking informal employment more accurately into account. The research emphasised the dual role of informal employment, as a means of exploitation and deprivation on the one hand, and as a means to develop ways out of poverty on the other.

This is an interrogation that has been present in informality research since then. Some authors have argued that informal practices might be positive in terms of being innovative and resilient: as they emerge from the bottom-up to answer specific needs, they are highly flexible and adaptable, and do address people's daily needs (Bangasser, 2000). Looking at the case of India's informal economy, Harriss-White (2015) finds that the "learning by doing" which is prevalent among informal workers is crucial in understanding that sector's innovation potential. The idea of "makeshift urbanism" (Vasudevan, 2015) explores the role of urban dwellers in building and maintaining infrastructure through their everyday practices and strategies - in a context where the state fails to provide such infrastructure. The self-provision of services (by urban dwellers for urban dwellers) has some key advantages, outlined by Turner (1968) in the case of housing. He argued that informal housing provision (that is, self-built housing as opposed to centrally planned, mass housing production) is an efficient and resilient type of urbanisation, and makes logical and economic sense. According to Turner, key benefits of self-provision are the fact that urban dwellers can build a house that is adequate to their needs (for instance, of the right size), but also according to their own capacity: they can build their homes incrementally, which allows them to save small amounts at a time or to make use of

existing or scavenged materials in order to slowly improve their homes. Turner thus argued that the government should accompany self-construction of housing by providing legal, technical, and financial support; that is, adapting the planning framework to informal processes, rather than attempting to fit these processes to a rigid planning framework. In terms of national and international policy, this meant focusing efforts on slum upgrading and incremental housing improvement, rather than legal aspects such as land tenure (Werlin, 1999).

In a seminal book on informal settlements in Mexico, Adler Lomnitz (1977) complements this analysis by arguing that the key assets of informal urban dwellers are the networks they build. Indeed, within informal settlements, "networks of reciprocal exchange" based on kinship and friendship develop within which people are solidary and help each other gain access to goods, services and jobs. It is thanks to these networks, Lomnitz argues, that marginalised urban dwellers manage to survive and integrate into urban life.

However, there have been criticisms of this emphasis on the role of the urban dweller to provide for their own needs. Although urban dwellers have been shown capable of building their own neighbourhood in the absence of the state, whether this is a desirable situation is up for debate. In particular, one has to be aware that this could be furthering the exploitation of an already vulnerable sector of society (Burgess, 1977).[1] This is confirmed by empirical data: in the case of Rio de Janeiro's favelas, Perlman found a situation of exclusion and exploitation of the urban poor. She explained that the urban poor can be exemplary citizens (socially cohesive, economically active, politically involved) yet not receive the benefits of the social contract: in her words, "integration does not necessarily imply reciprocity" (Perlman, 1980, p.245). The problem is the lack of integration of the urban poor into institutions such as health and education services, or into the employment market, a problem that cannot be solved by self-provision alone.

The economist Hernando De Soto shares some of Perlman's diagnostic. In his book *The Other Path*, he argues that informality causes poverty as it is a factor of exclusion from the formal market (De Soto, 1989). For him, the policy solution to this problem is the eradication of informality through various formalisation strategies (such as land titling) as the key to alleviating poverty and social exclusion. The informal economy is therefore depicted as a subsistence activity, from which one would have to "upgrade" to achieve a full integration in the capitalist productive system (Daniels, 2004).

[1] A similar argument has been made in the context of the informal economy, characterising informal workers, or "petty commodity producers", as the new exploited class of capitalist societies (Moser, 1978).

This strategy of formalisation gained momentum in the 1980s in international organisations and agencies fighting poverty, and was implemented in countries all around the globe (Hendrix, 1995). This strategy has had mixed results: to take the example of Peru, empirical research has shown that although formalisation strategies have had a positive impact by facilitating access to infrastructure (in particular electricity and water provision), there is no evidence that formalisation has eased the integration of households in the capitalist system, as they have not been able to use their property rights to secure credit (Kagawa, 2001). Empirical research in other countries in Latin America and Africa that have adopted formalisation strategies shows that there is no direct link between formalisation and physical consolidation of housing, and integration in the formal economic system; rather, these effects happen in certain contexts only (Hendrix, 1995).

This failure of formalisation policies to alleviate poverty can be explained, to a certain extent, by the erroneous conceptualisations of informality that underpin these policies. In Hernando De Soto's prescriptions for land titling as a means of fighting poverty, informal settlements have been misrepresented as areas of illegality and depravity. This oversimplification of what informality is, is widespread: the OECD defines the informal economy as the sum of people who avoid tax (Andrews et al., 2011), while the World Bank defines it as the productive activities that are "deliberately concealed" from the state (Schneider et al., 2010). As far as the topic of housing is concerned, this issue translates to the generalisations made about "the slum." In many international reports and much academic research, slums are presented as a marginal peri-urban area of the city where migrants settle, and that is characterized by vulnerability and socio-spatial exclusion (in particular from urban services and governance processes) (for example, see UN-Habitat (2003); Davis (2006)). This understanding of informality has had strong repercussions in the development industry. Gilbert speculates that international organisations have unintentionally participated in it (in particular by employing the value-laden term of "slums" in order to publicise their work and attract funding in a more efficient way) (Gilbert, 2007). This, according to the author, is very worrying because the exclusion of the informal settlements in urban life becomes a self-fulfilling prophecy, which results in counterproductive policy-making.

This might explain why in the 1990s and 2000s, international recommendations for policy have shifted away from the eradication of informality (with eviction and formalisation strategies) towards "slum upgrading," that is, the provision of infrastructure to informal settlements (UN-Habitat, 2003). More recently, UN-Habitat has also advocated the need for planners to recognis e the positive role of informal actors in the city, and to work toward a positive response

such as regularisation and upgrading, to be negotiated on a case-by-case basis (UN-Habitat, 2009).

Moving beyond normative accounts: the conceptualisation of informality in this research. Recent research developments have shown that it is not a helpful analytical concept to think of informality as inherently marginal or problematic (or, for that matter, as inherently resilient). The diversity of situations and local contexts has to be recognised, and robust research methods need to be developed in order to understand the role of informal practices in urban life, beyond normative assumptions of illegality or necessity, and towards a better understanding of urban environmental management. Two arguments have been put forward: firstly, informality has been oversimplified through normative constructions, and needs to be re-visited as a concept through in-depth ethnographic work (Varley, 2013). Secondly, in all the conceptualisations previously presented, informality is presented as separate, or in opposition to, formality. Roy suggests that this is erroneous, and rather that informality is *produced* by institutional structures, as what is labelled as informal depends on planning frameworks rather than anything else (Roy, 2005). These two arguments are explored in turn.

a. Building contextualised accounts of urban informalities. As soon as the 1980s, authors have challenged simplifications around informality: "the informal economy is not a set of survival activities performed by destitute people on the margins of society" (Castells and Portes, 1989, p.12). Indeed, considering that informality is the norm rather than the margins (as Castells and Portes do) requires attempting to achieve a complex picture of the diversity of conditions that informal actors experience.

Yet, simplification still remains a problem in informality research. As Varley (2013) demonstrates, even recent research on informality tends to perpetuate stereotypes, through looking at the informal city as a homogeneous whole within and beyond national borders. Varley argues that in order to reverse this trend, it is necessary to keep on engaging in ethnographic work in order to uncover informal actors' own perspectives of their role in urban life.

Indeed, the stereotypes around informality are continuously challenged by field research. While informal workers are traditionally depicted as marginalised and socially isolated, evidence shows that in the context of Latin America particularly, informal vendors tend to be well organised and are even seen as playing a key role in the urban economy due to their high entrepreneurialism (Cross, 2000; McFarlane, 2012b; Maloney, 2004). While informal actors are traditionally seen as powerless and absent from the political sphere, research shows how in a range of context, they can be powerful political actors (Thornton, 2000; Cross, 1998; Michelutti

and Smith, 2014). Looking at metabolic flows within African slums, Smit et al. (2017) also challenge the depiction of slums as a homogeneous whole.

One key finding of this empirical literature is that formality and informality are deeply interdependent. Particularly, urban formal and informal economies are intertwined and depend on each other, as materials, labour and capital move from one sector to another (Daniels, 2004; Mlinga and Wells, 2002).[2] These exchanges have been particularly studied in the case of e-waste recycling, in studies such as those of Grant and Oteng-Ababio (2012) or Streicher-Porte et al. (2005), which show that the e-waste recycling industry depends on the work of informal waste handlers. Looking at food consumption practices through a sociological and spatial analysis of Mexico City, Duhau and Giglia (2007) make the following observations. First, the increase in the number of supermarkets in Mexico City (the most formalised of food chains) has been accompanied by an increase in micro-businesses (that is, family-owned, informal food shops). Even though supermarkets have adapted their offer to the necessities of poorer urban households, the demand from the urban poor is still satisfied partly by informal food vending, taking the shape of street stalls and markets, small shops, and window-vending (the practice of vending food through one's home's window). One of the advantages of informal vending compared to supermarkets, besides low prices, is the availability of small quantities of food that are well-suited to poor households' consuming patterns and daily spending capacity. The other argument presented by Duhau and Giglia is that informal food vending also sustains (rather than being a mere alternative to) the formal economy. Supermarkets and malls, by paying very low wages, impede the employees' capacity to consume within the formal economy. Thus, it is common to find food stalls surrounding supermarkets and malls feeding the same employees that work within them (Duhau and Giglia, 2007).

This observation as to the interdependence of formal and informal urban economies has led some authors to reject the formal-informal dichotomy altogether, and to prefer the notion of a "continuum" (for a discussion, see McFarlane and Waibel (2012)). In this sense, informality is best defined as a "set of practices" (McFarlane, 2012a) which cannot be attributed to a particular socio-economic group of a given territory of the city, but that participate in a myriad of ways to the production of urban space.

b. Understanding informality as produced by planning structures. As a continuation of the empirical research, an argument has been developed that informality is best conceptualised as being *produced by* institutional frameworks.

[2]This argument has also been made in the case of informal settlements: formal and informal neighbourhoods are not separate entities, and they interact in many ways (UN-Habitat, 2009, p.132).

The non-urban literature presents a perspective of informality as being an inherent part of any social system. In organisational studies, informal practices and norms are described as those which are not codified or determined by written rules, yet are essential to maintain a formal system (Friedberg, 1997). Friedberg takes the example of the cooperation which may arise between workers in a factory, when machines unexpectedly fail. This interactions are numerous and are inherent to any social system. This is because although formal rules aim to reduce uncertainties, they rather tend to displace them, as they can never address all aspects of the relationships within a system. Thus, informal practices emerge as a way to address the deficiencies of the formal structures; this applies, according to Friedberg, to any social system, and therefore any formal business or institution, whether in the Global North or Global South. This idea has been applied to the role of the informal economy in society by Larissa Lomnitz:

"[Informality is...] an intrinsic element of 'formality' insofar as it is a response to the inadequacies of formalisation. [...] Every increase in centralisation and every additional attempt to control the economy increases the losses and delays due to inefficiency and thus stimulates the growth of informality as a palliative to scarcity. 'The more we organize society, the more resistant it becomes to our abilities to organize it' (Adams 1975:60). 'Order' creates 'disorder'. The formal economy creates its own informality." (Adler Lomnitz, 1988).

In this paper, the rise of the informality is explained by the failure of the formal economy to address social needs, and is, according to the author, *inherent to* any effort to regulate an economic system. An example that the author provides is the development of a black market of liquor during the United States Prohibition period. Another example is the clientelism, political favours and reciprocal relationships which emerge as a way to address the rigidities of a bureaucratic system.

This implies, as both Lomnitz and De la Peña (1996) argue, that informal relationships such as corruption, clientelism, kinships or favours all play a role in addressing the deficiencies of formal frameworks. These may exist, to different extents, in every sector of the economy. In this perspective, the argument that informality is tolerated by the state apparatus is justified by the fact that informality develops to address the inefficiencies of the formal system. For instance, the state tolerates the informal provision of urban services (such as public transport or waste management) which it is itself unable to provide (and the private sector unwilling to). In this sense, informality serves as a way to address those social needs mentioned by Lomnitz, and therefore to avoid social unrest (Castells and Portes, 1989, p.27).

In contrast, other authors take a more political stand, and argue that the use of "informality" as a concept is a "governmental tool" (McFarlane and Waibel, 2012, p.4), a device deployed

by government in order to justify particular interventions. As Roy puts it, "informality then is not a set of unregulated activities that lies beyond the reach of planning; rather it is planning that inscribes the informal by designating some activities as authorized and others as unauthorized" (Roy, 2009, p.10). By granting legitimacy to certain practices while denying it to authors, the government produces power: as Yiftachel (2009) argues, planning produces "the tools and technologies to classify, contain and manage deeply unequal urban societies". The categorisation of urban practices as formal and informal participates in this re-production of unequal distribution of resources and power, and is therefore undeniably a political activity (Roy, 2005).

c. Summary and the conceptualisation of "informality" in this thesis. Varley's argument on the necessity to document informality in a robust way through ethnographic work reminds the reader that informality as it exists in cities is a heterogeneous phenomenon: there is no single definition of "informality" which essentially encompasses all the diverse expressions of informality in contemporary cities. Rather, informal processes exist in different shapes in every city, and in an interdependency with formal processes. This has led authors such as Lomnitz to define informality as those practices which address the deficiencies of formal economic structures. In this sense, informality is inherent to any formal system and refers to a set of practices which does not follow codified and written norms. This conceptualisation is at odds with authors who see the use of informality as inherently political: as the government has the power to define which activities are legitimate and others are not, informality is a political tool which grants power to whoever uses it.

Thus, the informal economy is used as a concept in this research which addresses both these aspects. On the one hand, the informal economy represents those productive activities which are not codified and operate (partially) outside of regulatory frameworks. On the other hand, the informal economy is also defined as those activities the value of which is constantly negotiable (as argued by McFarlane (2012a)). This means that labelling a particular economy as informal is a way for the government to attribute a particular value (or lack thereof) and ensuing legitimacy to it. The next section turns to the concept of urban sustainability.

2.2.2 Urban sustainability

Urban sustainability is a determinant concept in this thesis because it is what drives the research: cities need to be made sustainable - this is high on the international agenda (as the UN Sustainable Development Goals show). Therefore, urban sustainability serves as the objective against which informal waste management is assessed. Yet, sustainability is a contested concept.

Environmental discourses and urban sustainability. In his seminal book *The Politics of the Earth*, Dryzek (1997) identifies the environmental discourses that have dominated the environmental agenda during the second half of the 20th century, and demonstrates how the assumptions and paradigms embedded in each discourse determine the way environmental problems have been thought of, conceptualised and governed.

Dryzek defines discourses "a shared way of understanding the world, [...] used to construct meanings and relationships, helping to define common sense and legitimate knowledge" (Dryzek, 1997, p.9). Environmental discourses are such ways of understanding the world which influence how we think normatively in terms of society's relationship to nature. As Hajer has argued, environmental discourses (our conceptualisations of nature) determine the way we think about the environment, in which ways it is endangered, and which possible solutions to put forward. They are thus mobilised when making decisions as to how nature is to be used or protected (Hajer, 1995). Therefore, framing discourses is an instrument of power, as has been shown in the field of political science:

"Governmental discourses methodically mobilize particular assumptions, codes, and procedures in enforcing specific understandings about the economy and society. As a result, they generate 'truths' or 'knowledges' that also constitute forms of power with significant reserves of legitimacy and effectiveness. Inasmuch as they classify, organize, and vet larger understandings of reality, such discourses can authorize or invalidate the possibilities for constructing particular institutions, practices, or concepts in society at large". (Luke, 1995)

The quote above means that concepts such as "urban sustainability" are discourses which are made up of assumptions as to human's relation to nature. Because such discourses impact on decision-making, it is important to reflect on the assumptions embedded within them.

Dryzek (1997) identifies and characterises four main environmental discourses, two of which - according to Dryzek - are most prominent at the time of writing the book. Those, which he puts in opposition, are the "quest for sustainability" and "green radicalism". Proponents of sustainability aim to reform the economic system so that it acts within the environmental planetary boundaries. Thus, they propose to "dissolve the conflict between environmental and economic values" (Dryzek, 1997, p.16) that arise within our capitalist, industrial society. Green radicals, on the other hand, see this conflict as unsolvable within the current industrial paradigm, and thus put forward the need for "alternative interpretations of humans, their society and their place in the world" (Dryzek, 1997, p.16).

This example shows how different assumptions are embedded within environmental discourses: proponents of the sustainability discourse believe in the compatibility of economic

growth with environmental protection, which is not the case of the green radicals. There are also finer distinctions within those broad discourses, such as the difference between strong and weak sustainability (which depends on the belief that ecosystems have an intrinsic value and should be protected as such, or, on the contrary, that ecosystem services are substitutable and can be replaced by human or manufactured capital) (Neumayer, 2003).

Dryzek's characterisation of environmental discourses is helpful in unpacking the assumptions embedded in contemporary discourses of urban sustainability. As Fu and Zhang's (2017) bibliometric analysis shows, the concept of urban sustainability has been used over the past decades in academic research, with distinct interpretations and alongside other concepts (for instance, that of the "eco-city" or the "smart city"). Fu and Zhang argue that what distinguishes the concept of sustainability is its concern, beyond the environmental impact of cities, for social and economic considerations. Similarly, in another bibliometric study of academic discourses promoting sustainable urbanisation (de Jong et al., 2015), the "sustainable city" is identified as a discourse which puts forward the balancing act that is needed between improvements in the quality of life with a reduced consumption of resources from the city's hinterland. Thus, the concept of "sustainable city" contrasts with other discourses, such as that of the "low-carbon city" insofar as it goes beyond the environmental impact of cities to include social and economic considerations. Yet, the "sustainability discourse" is itself composed of a range of views which operate alongside a spectrum, depending on the pathways that are put forward and the emphasis that is put on the role of technologies in such pathways.

On the one hand, the discourse of the "ubiquitous eco-city" (Joss et al., 2013) is a way of addressing the dual concern of urbanisation and climate change through a sustainable cities discourse. What characterises this discourse, according to the authors, is a focus on technological solutions aimed at optimising energy systems and reducing greenhouse gas emissions. It proposes an ecological modernisation through investments in clean technologies. In this modernisation, the role of the private sector is essential, through investments, innovation, and construction. This discourse of ecological modernisation is arguably dominant in 21st century environmental politics; central to it is the idea that protecting the environment is a "positive-sum" game, that is to say, that it can be reconciled with objectives of economic growth (Hajer, 1995). In that sense, the eco-city discourse shares some of the assumptions of what Dryzek identified as the reformist "quest for sustainability". The main solution proposed to foster a low-carbon society, in this perspective, is the investment in technological innovations. Recent research has suggested, however, that this discourse may not be automatically compatible with moving towards an ethically just low-carbon society – especially with regard to the inclusion of

citizens' experiences and demands into the agenda, balancing the interests of the private sector (Joss et al., 2013).

At the other end of the spectrum, and bearing similarities to Dryzek's description of "green radicalism", exists another discourse which is critical of this practical, techno-centric and carbon-focused approach to urban sustainability. This view, being more critical of the neoliberal agenda of economic growth, is less prevalent in the literature, although it can be found within the school of thought of environmental justice and urban political ecology (Caprotti, 2014; Cook and Swyngedouw, 2012). In this literature, the ecological modernisation paradigm is criticised on the ground that it may not be automatically compatible with moving towards an ethically just low-carbon society – especially with regards to the inclusion of citizens' experiences and demands into the agenda, balancing the interests of the private sector (Joss et al., 2013). This is the base for the production of alternative discourses on sustainability pathways based on locally-adequate, context-based solutions to environmental challenges. While the ecological modernisation agenda promotes the transfer of knowledge and technologies across countries, this critical view favours the use of local knowledge in order to provide solutions that are adapted to local financial and technical resources, as well as social, cultural and political characteristics. In this view, the solutions are to be holistic (not only addressing carbon emissions but also issues of inequalities, well-being, as well as other environmental challenges such as water scarcity or local pollution) and can happen at very low scales, involving all citizens and not only the private sector.

The embodiment of these assumptions in discourses can be observed beyond academic writing: Chapter 5 explores the wide range of discourses used by policy-makers in Mexico City to conceptualise urban sustainability. The concept of sustainability appears as socially constructed and inherently political, and particular focus is put on which conceptualisations of sustainability are put forward and with what consequences. Indeed, Chapter 5 explores not only the discourses themselves, but how they are mobilised, and how this may help explain why informal actors have remained invisible in the sustainability agenda.

Without denying the co-existence of multiple understandings of urban sustainability, it is necessary to state what definition is used in this thesis to assess Mexico City's informal waste management system.

The use of the concept in this thesis. In this thesis, I use the definition developed by Rydin (2010) in her book *Governing for Urban Sustainable Development*, which relates urban sustainability to the definition of sustainable development as it was presented in the Brundtland report (World Commission on Environment and Development, 1987). This report proposes to

reconcile the agendas of development and the protection of the environment. The definition of sustainable development, reproduced below, therefore combines to key components: that of providing for the needs of all human beings, and particularly the world's poor; and to do so within the limits imposed by the planet's ecological boundaries.

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (World Commission on Environment and Development, 1987, chapter 2)

The report, in this sense, takes a radical stand, by stating that our society will never use the environment in a sustainable way as long as some do not have access to the resources necessary to fulfill their basic needs. The concepts of inter- and intra-generational equity are at the core of this definition of sustainable development.

How can this definition be applied at the urban level? Rydin (2010) proposes that urban sustainability is composed of three aspects, all related to the definition of the Brundtland report:

- "the extent to which activities within urban areas contribute to unsustainable outcomes";
- "the possibilities of urban areas to render economic development more sustainable";
- "using the urban level of governance to pursue action for sustainability, and to demonstrate commitment to the sustainable development agenda." (Rydin, 2010, p.11)

In this definition, urban sustainability is defined as the capacity of cities to contribute to the sustainable development agenda; that is to say, to limit human consumption of natural resources, to decouple economic growth from environmental harm, and to lead actions for global sustainability at the local level. Urban sustainability is therefore related to multiple scales. The buildings of a city, for instance, may play a role in natural resources consumption (as eco-friendly designs may produce their own electricity and harvest their own water). A city's transport or waste management system may, at the urban scale, participate in a decoupled economic growth. Likewise, innovations at the city scale, such as urban food production systems or rainwater harvesting may reduce the city's dependence on its hinterland, and therefore reduce the strain on nearby and remote ecosystems. They may also participate in a more equitable distribution of such resources between urban dwellers.

Urban sustainability rests on four pillars (Rydin, 2010). (1) The environment refers to a use of ecosystem services (natural resources and absorption of waste) which does not exceed the capacity of ecosystems to regenerate. (2) The social pillar refers to the development agenda, which is that of meeting all humans basic needs, and achieving an equitable distribution of resources between humans (including future generations). (3) The economic pillar refers to using

market-based dynamics to provide the material conditions for human life. (4) The governance pillar refers to stable and accountable institutions which allow for participation by all, particularly by those populations affected by socio-environmental change.

This definition of sustainability may appear vague, in the sense that it identifies areas where urban sustainability may be at play and a vision of a desirable future, yet it does not discuss potential pathways to get there. This is on purpose, and is justified by the idea that there is no single pathway to achieve sustainability - rather, each city may define their specific objectives, priorities and pathways in a participative manner (Rydin, 2010; Guy and Marvin, 1999).

The relation between sustainability and environmental justice. As discussed earlier, a strong component of sustainable development (as stated in the Brundtland report) is that of equity: "Even the narrow notion of physical sustainability implies a concern for social equity between generations, a concern that must logically be extended to equity within each generation" (World Commission on Environment and Development, 1987, chapter 2). The report argues that the willingness of all people to achieve a good quality of life is not only legitimate, it is necessary, as a world with poverty and inequity will always be prone to crises which endanger sustainable development.

This argument has been taken forward: the Sustainable Development Goal n.11 ("Make cities inclusive, safe, resilient and sustainable") acknowledges this interdependency between objectives of environmental protection and equity in the access to resources by the population. As a result, the New Urban Agenda's exhortation to 'leave no one behind' also means considering the fair distribution of natural resources, services, and environmental risks.

Schlosberg (2004) has defined environmental justice has having three components: the fair distribution of environmental benefits and burdens, the recognition of the diversity of actors and their experiences, and the inclusive participation in political processes in relation to environmental policy. Authors have argued that the agendas of sustainability and environmental justice are inherently linked. As Agyeman et al put it:

"Sustainability cannot be simply a 'green', or 'environmental' concern, important though 'environmental' aspects of sustainability are. A truly sustainable society is one where wider questions of social needs and welfare, and economic opportunity are integrally related to environmental limits imposed by supporting ecosystems." (Agyeman et al., 2003, p.78).

This quote intuitively links sustainability to issues of welfare and equity - similarly to the Brundtland report. Yet, what is the relationship between the two concepts? As Dobson (2003) has pointed out, there is no empirical evidence that sustainability necessarily depends on environmental justice (or vice versa). Even more, Dobson points out that the objectives of

sustainability and justice may be contradictory - for instance, the notion of an intrinsic value of nature (when there is no direct benefit to humans) is a component of (strong) sustainability but not of necessarily of justice, which focuses on fair distribution of environmental benefits among humans (Dobson, 2003).

Ehresman and Okereke (2014) explore the compatibility of the green growth discourse (which they identify as the major sustainability discourse) with concerns for environmental justice. They argue that the two concepts are compatible, but not necessarily interdependent, and therefore that the green growth concept "remains subject to different interpretations in different venues and is harnessed to widely differing policy aims and objectives." (Ehresman and Okereke, 2014, pp.23-24). In parallel, Okereke explores the compatibility of three dominant environmental regimes (the Third UN Conference on the Law of the Sea, the Basel Convention on the Transboundary Movements of Hazardous Wastes and their Disposal, and the United Nations Framework Convention on Climate Change) with concerns of global environmental justice, and argues that these dominant regimes use notions of justice that are consistent with a neoliberal economic agenda, and which as a result "are incapable of delivering on the promise of distributive justice" (Okereke, 2008, p.3). Thus, despite the call for the inclusion of concerns of environmental justice in urban sustainability, this has not translated to action in policy circles. Rather, the policy agenda is dominated by a discourse of "green growth", which is at best independent from, and at worst incompatible with, environmental justice.

In response to these claims of incompatibility between the sustainability and the justice agendas, perhaps the most compelling answer has been that the two agendas ought to be combined on moral grounds. For instance, Swilling and Annecke argue that the sustainability transition does not *need to be* environmentally just - yet, changing our patterns of resource consumptions in order to make them more sustainable, is a unique opportunity to address issues of inequity in the access to such resources: "the innovations, investments and interventions required to address resource depletion and impacts [are] unique opportunities to simultaneously address the wide range of fundamental needs of everyone, but in particular the world's poor" (Swilling and Annecke, 2012, p.xxii). Similarly, Myers (2008) argues that both movements can cross-fertilise and may be more successful in achieving their goals by joining forces. There is reason for this argument, as some components of the environmental justice agenda (such as the fair distribution of natural resources, or a participatory and inclusive governance system) are common to that of the sustainability agenda.

In order to contribute to this debate and to answer to Dobson's call for more empirical research on the topic, this thesis reflects on the relation between concerns of sustainability and

environmental justice in the case of urban waste management; this will be one of the topics discussed in Chapter 8. The next section presents urban metabolism as a research framework which can enable such an approach to the topic of waste management.

2.2.3 Urban metabolism

Urban metabolism is the process of material exchanges between the city and its natural environment. Using urban metabolism as a framework in urban research involves focusing on material flows within the city as a potential way to uncover environmental, social, economic and political aspects of resource distribution in a holistic way.

The metaphor of urban metabolism makes resource flows visible. Modern society is increasingly defined by flows, networks and movement (Castells, 2010; Urry, 2007). Material flows in particular play a crucial role in issues of urban sustainability as they determine the distribution of natural resources amongst the urban population. Because of this, researchers have argued that urban resource and material flows are the key "intervention point" to achieve urban sustainability (Hyman, 2013), which can be studied through urban metabolism.

The roots of the concept can be found in Marx's writings on social metabolism (in which he conceptualises the physical separation of the place of extraction and that of consumption of natural resources, characteristic of urbanisation, as a "metabolic rift", and warns against the potential hazards to the environment associated with such a linear system) (Marx, 1887, 1959). Throughout the second half of the 20th century, the concept of social metabolism has been applied to the study of urban systems in order to understand a wide range of issues related with the consumption and transformation of natural resources in cities. In particular, studies have focused on urban environmental pollution (Wolman, 1965), resource requirements of urbanisation (Newcombe et al., 1978), or material flows and stock within cities (Rosado et al., 2014). Urban metabolism studies are found predominantly within Industrial Ecology, a relatively recent academic field which explores material flows in industrial systems by adapting methods from ecological studies. Within this field, many scholars have emphasised the potential for the mimicry of natural ecosystems to lead to greater conservation of resources and environmental protection (Jensen et al., 2011).

The materiality of resource flows. Industrial Ecology has given strong attention to the materiality of urbanisation through the quantification of urban material flows. This has been achieved by adapting sustainability indicators (such as life cycle assessments or ecological footprinting) to the urban scale.

Material flow analysis (MFA) is the main research tool that has been used in the field of industrial ecology in order to analyse urban material flows. An MFA is a model of flows described

in terms of inputs, outputs, and stocks. Using an MFA at the urban scale entails drawing conceptual boundaries around the city and quantifying the input and outputs of materials through these urban boundaries. The flows are then quantified in terms of mass or energy equivalence. Kennedy et al. have developed a method to quantify the energy throughput of different cities, translating it in terms of GHG emissions, by adding up the GHG associated with different energy uses (fuel, electricity, gas) and additional activities (for instance, waste management) (Kennedy et al., 2010). More recently, this method was extended to material throughput, as applied to the case of ten megacities (Kennedy et al., 2014). Similarly, research on the metabolism of Paris takes the form of an MFA (Barles, 2009) in which the city is black-boxed in order to generate an exhaustive account of material inputs and outputs to the city-region. This is done at three scales (the inner city, the extended city, and the region). Indicators of material throughput measure the material consumption of the city, that is, the material input and material outputs of the city and of its suburbs and regions. Data on the quantity as well as the types of material flowing between these regions can be the basis for the design of strategies to achieve a more sustainable throughput of materials in the city-region.

An MFA is thus a diagnostic of a city's environmental performance that can be used as a basis to evaluate policy alternatives for system optimisation. Resource use in the city can be optimised by mimicking natural ecological systems (which are closed and self-sufficient). This is the foundation for research in circularity, in particular in circular metabolism. In his book, *Cities People Planet*, Girardet (2004) explains that ecological systems are sustained because they are closed systems with a circular metabolism. That is to say, the waste of some species becomes the resource of others. In this sense, ecosystems require no input of resources from outside the system (except for energy), nor do they produce waste. Girardet argues that the key to the sustainability of cities is to mimic this feature of ecosystems, and attempt to make the metabolism of cities circular. Enhancing the circularity of flows within the urban system by matching waste streams with resources allows for a reduction of inputs and outputs, which lowers the environmental impacts of the city. In practice, this has led to the implementation of zero-waste systems, examples of which can be observed at the industrial and neighbourhood level by identifying "symbiotic opportunities" (Geng et al., 2010). In this sense, circularity in resource flows is seen as one of the ways to achieve urban decoupling (continued urban growth with reduced resource use), one of the conditions for green growth (UNEP, 2013).

Urban metabolism research has also gone beyond looking at the environmental performance of cities. Newman (1999) in particular argues for an extension of the metabolism model to include the social aspects of urban sustainability: in his view, the human and physical factors

of resource flows have to be studied alongside each other, because "cities are much more than a mechanism for processing resources and producing wastes, they are about creating human opportunity" (Newman, 1999, p.222). Considering that one objective of urban sustainability is the quality of life of its inhabitants, Newman argues that one output of the metabolism must be the liveability gained in the process of resource use. Therefore, the sustainability of a city cannot only be measured by the reduction of its resource flows. Liveability also has to be taken into account (an idea that exemplifies the potential synergies and trade-offs between environmental and social factors of sustainability). Newman creates an indicator for urban sustainability that is made up of environmental indicators (energy productivity, waste production, land use changes among others) as well as social ones (health, education, safety, leisure opportunities, for instance). Another example is Pincetl and colleagues' "expanded urban metabolism method," which is a framework for integrating environmental, social, economic, and political aspects of urban metabolism in one indicator (Pincetl et al., 2012). The framework engages explicitly with political and social aspects of resource use; however, the authors acknowledge the difficulty to study infra-urban processes with an industrial ecology approach, and thus highlight the limitations of current research methods to provide a meaningful political account of cities' metabolism.

Considerations of informality in urban metabolism research. A few studies explicitly address informality in relation to urban metabolism research. With regards to informal housing, a study of an informal settlement in Cape Town is particularly relevant (Royden Turner, 2012). In it, Royden Turner sets out to assess the city's housing upgrading policy (one of eradication of informal settlements through relocation in affordable new housing) on the basis of social and environmental considerations. Combining the urban metabolism framework with participatory mapping enables the author to produce a Material Flows Analysis of the informal settlement. The main finding of the study is that in an informal neighbourhood, productive and domestic activities can be mixed and the boundaries between them blurred, as they both take place within the home. The combining of these two activities is found to favour the circularity of material flows between the two systems, which improves resource efficiency. This suggests that the way urban metabolism research currently manages productive and domestic activities (as geographically and materially separate) is inadequate to accurately represent the informal city's everyday practices and their associated material flows.

With regard to the informal economy, one interesting study is that of flows of wood and paper in Cape Town (Nissing and von Blottnitz, 2007). Its objective is to assess the municipal energy strategy and to enable the design and evaluation of policy alternatives. Faced with an

absence of data on these flows, the study generates a Material Flow Analysis of wood and paper. The data is extracted from a wide variety of sources, in particular existing publications, public databases, interviews and site visits. The data on the formal use of wood and paper is complemented with interviews of informal stakeholders, that is, inhabitants and wood traders of informal settlements. This allows the authors to track wood and paper flows more accurately through the city, by shedding light on informal transactions, uses and transformations of wood in Cape Town's informal settlements. This research shows that environmental flows move through the formal and the informal economy during their life-cycle, creating an interconnectedness between the two sectors, which is not accurately captured in trade statistics. Thus, a mix of data-collection methods is required in order to track a material flow through the urban system.

Both of these works use unconventional approaches to urban metabolism research as they rely on methods such as site visits and interviews; this allows them to assess the contribution of the informal city to urban sustainability. In particular, it appears evident in both studies that environmental and social data cannot be understood separately. In both cases, stakeholders are identified and participate in data collection. One important aspect of the two studies is that there is a reliance on experiential knowledge that is traditionally not used in environmental research. As a consequence, one can observe that the research design that is used is one of mixed-methods, as both quantitative and qualitative methods are used to gather data; and triangulation is applied between different techniques to strengthen the validity of results. This seems to indicate that successful research methods in this context need to be mixed and flexible.

In these examples, MFA appears a promising tool to understand urban resource flows. Tracking and quantifying flows of natural resources is an important contribution to the study of the production of urban space and urban sustainability. However, it is essential to acknowledge that MFA diagnostics represent just one city narrative. By basing the analysis on somewhat rigid methodologies of material accounting (for instance, by favouring large-scale quantitative datasets and by black-boxing the city), the generation of an MFA follows implicit rules about the inclusion or exclusion of certain types of datasets, knowledge, and narratives. These methodological considerations are rarely reflected upon in MFA research, thus constraining one's understanding of the city to a dominant narrative. If MFA is to be used as a research tool to analyse the relation between cities and the environment, its research design has to allow for the expression of the diversity of narratives of the city, such as one of informal flows of materials and resources. Its production therefore has to be politicised. This can be done by building on a body of literature, often grouped under the, umbrella term 'Urban Political Ecology', which relates urban metabolism to the production of environmental injustices in the city

by exploring how resource flows are embedded in processes of material accumulation (Cook and Swyngedouw, 2012; Heynen et al., 2006a).

The politicisation of urban flows. Political ecology highlights the politics behind environmental flows, and in particular how the production of social inequality is correlated to the use of resources. Looking at the city scale, urban political ecology theorists have pointed out two aspects that shape the production of urban environments: first, the use of resources is shaped by inequalities in distribution of resources and environmental impacts that are most often reinforced by the dominant power structures of global capitalism (Cook and Swyngedouw, 2012); second, these inequalities can only be understood with reference to the specific contexts in which they become visible, within particular histories and narratives (Desfor and Keil, 2004; Kaika, 2005). Here, how the environment is produced, thought of, and classified is central to understanding how spatial inequalities are produced. For urban political ecologists, this relates closely to the notion of flows and how flows are embedded in the social production of the city (Heynen et al., 2006b).

Urban political ecology emphasises the political consequences of specific configurations of urban flows. The urban metabolism framework is thus used to analyse the politics of resource flows within the city and their distribution in a qualitative manner, highlighting issues of social inequity and environmental injustice (Heynen, 2013). This requires looking both at the city's resource requirements and its relation to its surrounding environment and at the intra-urban distribution of environmental benefits and burdens. "Processes of metabolic change are [...] never socially or ecologically neutral" and thus, materiality is inherently embedded in urban politics (Heynen et al., 2006b, p.10). Issues of power and justice are of particular importance that can be disentangled through the analysis of the actors who control metabolic processes, and those who win and lose from the distribution of resources in the city. Demaria and Schindler (2015) take a political approach to urban metabolism by looking at political conflicts emerging around the implementation of a waste-to-energy programme in India, and the political negotiations that emerge.

An underlying assumption in urban political ecology is the conceptualisation of "the city as a socio-ecological process" (Heynen et al., 2006b). In urban political ecology, the dichotomy between the urban system and the natural environment is questioned. Nature does not only exist in the wild but also in the built environment. In addition, in the city there are no clear margins between the social and the natural, and both realms are interdependent. As a result, urban political ecology research encompasses social, political, legal, economic, and environmental

dimensions of natural resources flows. Spatial boundaries are also blurred as the analysis moves between the household, the neighbourhood, the city or the hinterland as required.

One of the focal points in urban political ecology research is a challenge to dominant narratives of the urban environment. This can be achieved by documenting the experiences and practices of traditionally marginalised groups. One example is research undertaken in Mumbai on open defecation (Desai et al., 2014). In this research, the dominant storyline (characterising open defecation as a public nuisance that needs to be prohibited) is put into question by producing alternative narratives based on the experiences of the urban poor. The authors conduct an ethnographic research in order to go beyond the common understanding of the problem. Their objective is to deepen this understanding, and by doing so they question proposed policy options: their findings show that improving the quality of public toilets (in terms of cleanliness and affordability among others) might be a more efficient policy tool than a prohibitive one (such as a fine). As this example shows, documenting alternative narratives (in this case, of daily experiences in informal settlements) can uncover essential information about the life of the urban poor and the social inequalities they suffer as they are produced within the urban infrastructure landscape.

There have been criticisms to using urban political ecology as a main research framework when studying material flows due to its lack of rigour in analysing the materiality of flows. The urban political ecology approach, by focusing on the politics of resource use, can be weaker in its analysis of environmental processes and flows (Newell and Cousins, 2014). The lack of reliable environmental data analysed in a systematic way as well as the overall domination of qualitative research outputs mean that urban political ecology insights cannot be related to wider urban processes of material flows. These studies are therefore not enough on their own to understand the relation between particular informal practices and urban-wide processes, in particular, in terms of sustainability. Even though urban metabolism has to engage with neighbourhood-scale and political aspects of resource use, we cannot leave behind the quantification of flows, which provides necessary information to assess the sustainability of resource use. However, data relating to material flows as it is currently produced (that is, through expert-led analysis) does not represent the diversity of narratives, but rather reinforces the dominant understanding of urban material flows. Methodologies like Material Flow Analysis have the potential to reveal material politics as they unfold in urban areas, but only if their fundamental assumptions (the underlying focus driving them) are put under scrutiny. To this end, the urban political ecology approach is used to scrutinise the assumptions embedded in MFA design, and therefore to politicise the urban metabolism framework as defined traditionally in Industrial Ecology.

The first assumption is one of system boundaries: within Industrial Ecology, urban metabolism research focuses on the city as the object of study and frames it as a homogeneous, static entity. Once the system boundaries are set around the city, it becomes impossible to look at what happens within, outside or beyond the urban system: material flows become an indistinct "black matter" that veils the specific modes in which the flows circulate and inequalities are embedded in these flows. However, material flows cannot always be studied by looking at the city scale alone: looking at the case of water flows in Mumbai, McFarlane argues that "addressing [...] metabolic inequalities requires more than addressing water alone" (McFarlane, 2013, p.499): this means looking at processes that affect water use, such as housing, water saving practices or agricultural policy. Likewise, it is necessary to look beyond the city scale, within homes, municipal offices, corporate practices, or irrigation pipes (McFarlane, 2013, pp.498-499). Recognising that natural resources flows are not just material, but are entangled with spatial, social and political practices, which are embedded in a particular place, is a first step towards politicising urban metabolism research. In order to do so, it is necessary to challenge the conceptualisation of the city as a "black-box", looking instead at processes of urbanisation and how flows are produced and circulated, regardless of their scale.

The second assumption relates to how flows are conceptualised. In an Industrial Ecology framework, flows are conceptualised as items that can be isolated in space and time, in order to be quantified. However, framing flows in this way *de facto* restrains which flows can be included in the research: some flows cannot be quantified (for instance, because there is no data readily available about them, or because they evolve very rapidly and thus cannot be estimated for a specific point in time), and thus tend to not be included in Industrial Ecology research. On the other hand, not all the interesting data about material flows is of a quantitative nature. Flows also matter because of the people who interact with the material, which practices these flows enable, and how they distribute power in a context of capitalist globalisation. As such, waste workers, their daily lives, values, and working conditions should be an essential aspect of a waste metabolism analysis. Thus, I propose a conceptualisation of waste flows as dynamic, not always -or not fully- quantifiable, and as related to other components of the urban system, such as society, workers, productive activities, and governance. Material Flow Analysis is approached not as a rigid framework but rather as a data-gathering tool through which different actors can be engaged in producing narratives about resources flows in their city; the overall objective being to build a political analysis of material flows that is pluralistic and addresses issues of environmental justice.

Urban metabolism is used as a concept which frames the research. In order to address the inherently political discussions of sustainability and informality, the framework needs to be politicised by challenging assumptions of flows and system boundaries. The implications in terms of research design are discussed in Section 4.2 of the Methodology chapter of this thesis.

2.3 Conclusion

The literature review demonstrates that because informal workers participate in the production and maintenance of infrastructure networks, and that those infrastructure networks are key determinants of urban sustainability, then informal workers are crucial actors in urban sustainability. Yet, there is a gap as to how informal economies impact on urban sustainability. The urban waste management literature provides an insight that addresses such a gap: research on informal waste workers shows how they engage in activities of waste collection and recycling, and how these can make up a significant proportion of the overall waste management system. Yet, the contribution of this system to urban sustainability beyond resource recovery has not been explored.

Narrow conceptualisations of sustainability (particularly in the waste management literature) have locked the debate within considerations of resource efficiency and environmental impacts, while overlooking issues of environmental justice. In this research, the informal waste management system is assessed based on a definition of urban sustainability that takes into account concerns of social equity.

Methods have been lacking to address this issue. Therefore, the last section of this chapter presented the concept of urban metabolism, which - as long as it is politicised - provides an adequate methodological framework to bridge the research gaps. Chapter 4 picks up this discussion by presenting the methodological approach taken in the research. Before this, Chapter 3 explores how the research gap identified presents itself in the particular context of a case, that of Mexico City.

Chapter 3

Informal waste management in Mexico City

This chapter presents and contextualises the topic of informal waste management in Mexico City by exploring the topic of informality. Informal processes and interactions have played a key role in the city's development, from small scale daily activities of individuals to the strategic urban-wide political negotiations. Research has explored how informal practices have shaped the construction and consolidation of human settlements (Adler Lomnitz, 1977), trade and the access of everyday goods and services by urban dwellers (Adler Lomnitz, 1977; Cross, 1998), everyday interactions in the public space (Duhau and Giglia, 2008), and the governance and politics of the city (Davis, 1994; Cross, 1998)). Informality is therefore a defining chatacter of Mexico City.

Indeed, Chapter 2 argued that many processes shape urban outcomes: the city is not the exact result of the design and implementation of a combination of laws, policies and land-use plans. Rather, it is an assemblage of planning processes and daily practices; these practices can be more or less formally codified. The role of daily practices in shaping the city has been acknowledged in sociological urban studies (see for instance Duhau and Giglia (2008)) but is not reflected in sustainability research. While the formal urban activities are the focus of environmental studies, we still lack the methods and frameworks to study informality in relation to urban environmental management. Although the existence of informal waste handlers is undeniable, very little research shows how those informal actors participate in urban waste management. In this chapter, we explore this phenomenon in the case of Mexico City.

This chapter starts with a presentation of Mexico City in its geographical and metropolitan context, so that the reader can get familiar with basic facts about the city. It also briefly describes Mexico City's development in the 20^{th} century, and the role of informality in this process - looking in turn at spatial informality, economic informality and informal governance. In the following section, the waste management system is presented. Describing waste flows highlights the role of informal actors in waste management; on the other hand, presenting waste

governance mechanisms reveals the exclusion and invisibility of informal actors in decision-making. Finally, the last section presents the case of Tepito, arguing that the study of Tepito's waste metabolism will reveal insights as to the role of informality in sustainability. Tepito's historical construction through informal processes makes it an excellent case to explore informal urban waste management.

3.1 Presenting Mexico City

3.1.1 Geographical and metropolitan context

Mexico City is Mexico's capital and is located in the central region of the country (Figure 3.1). Mexico City's population is 8,885,108 and its area is 1,456 km^2, although the urban area only represents just over half of the total land area (the south of the city is mainly rural and has been declared a preservation zone).[1] Administratively, Mexico City is one of the country's thirty-two states (and comprises sixteen municipalities). However, the city's urban expansion has led to the physical formation of a metropolitan area, as previously rural or semi-urban municipalities from the neighbouring states have been progressively integrated in the urban fabric. The National Geography and Statistics Institute[2] defines Mexico City Metropolitan Area as made up of Mexico City as well as sixty neighbouring municipalities in the State of Mexico and Hidalgo (see Figure 3.1). As of 2010, the total population of the metropolitan area is 20,116,842 inhabitants, scattered on 7,819 km^2.

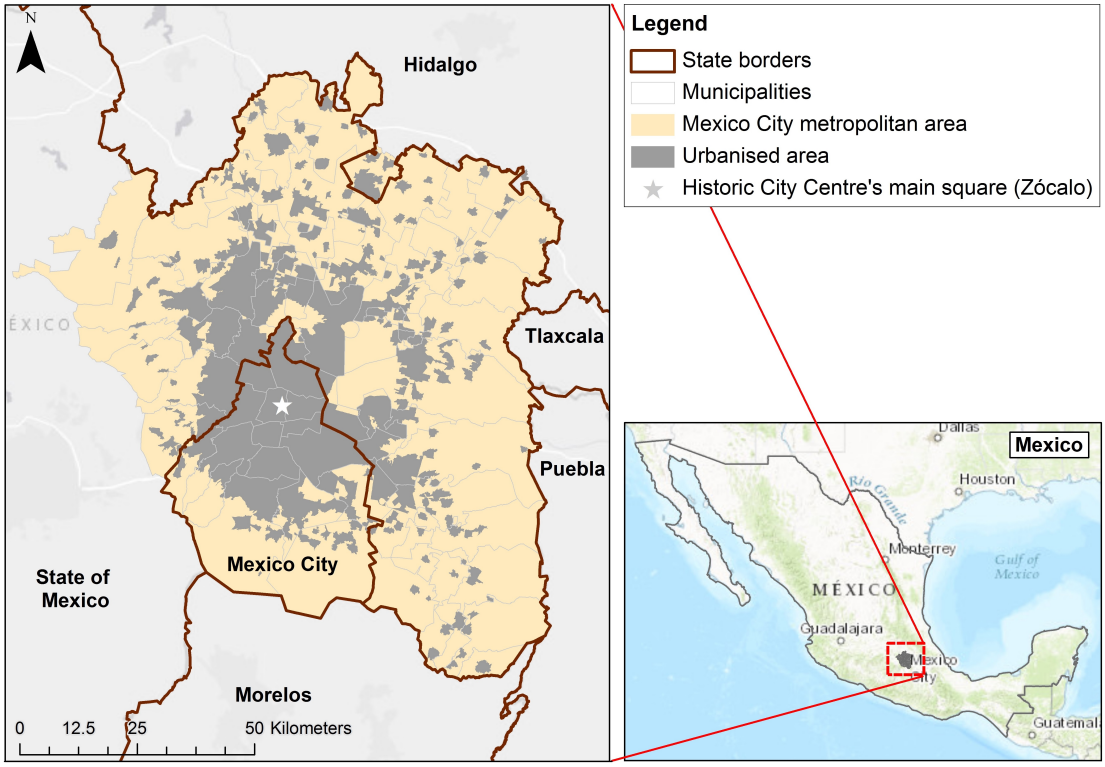
Mexico City's development has been shaped by many factors, first of all its geography: Mexico City has an altitude of 2,421 metres above sea level, and is set in a flat basin surrounded by mountains that reach up to five thousand meters (Figure 3.2). This has implications for the city's metabolism, as the urban system is physically separated from its hinterland by the mountain ranges. The city imports most of its electricity, biomass and food - and a third of its water supply - from neighbouring states, where it also exports its liquid and solid waste - as such, the city's metabolism is mostly linear (see Delgado Ramos et al. (2012)).

Both the import of water and the export of waste are politically and economically costly: imports of water from rural areas to address the ever increasing urban demand has created environmental conflicts between the capital's administration and its rural counterparts, where water shortages (both in terms of domestic and agricultural consumption) have been experienced (Tortajada, 2006; Cairé Martínez, 2005). In parallel, the export of Mexico City's solid waste to its metropolitan area (mainly in the State of Mexico) can be the source of political tensions, as

[1] The population and land use data presented in this section is taken from the 2010 Mexican Population and Housing Census (INEGI, 2010). Although some estimates have been produced for the year 2015, they are only available at the federal and state level, and do not present data at the metropolitan, urban or local scales.

[2] INEGI, for its Spanish initials.

Figure 3.1: Mexico City and its metropolitan area



Source: Own elaboration, using data from INEGI (2010)

Figure 3.2: Mexico City and mountains to the east

Credits: Kasper Christensen, September 2011. License to share and distribute, accessed online at: https://www.flickr.com/photos/kc{_}aplosweb/6142323949/

was the case in the Spring of 2016, when an environmental crisis made the front page of national newspapers (see Figure 3.3). Facing one of the city's worst air quality crises since the 1990s, Mexico City's governor decided to declare an environmental contingency plan, where cars would not be allowed to be used one out of every five days. Cars from the metropolitan area, belonging to the commuters from the State of Mexico, were particularly targeted by this plan. The State of Mexico's governor saw this situation as unfair; he reacted with a public discourse in which he blamed Mexico City for creating environmental problems without considering their impacts on the metropolitan region. He stated: "[For Mexico City's government,] it has been easier to generate solid waste, and to deposit it in their neighbour's house, that is to say, the State of Mexico" (Salinas Cesáreo, 2016). Contesting the claim that State of Mexico's residents were the main contributors to Mexico City's air quality crisis, and highlighting the local pollution generated in the State of Mexico from managing Mexico City's waste, the governor decided that in order to balance the situation, the State of Mexico would stop receiving Mexico City's waste. This led to a public health and political crisis, in which Mexico City's government had to spend two million Mexican pesos a day (121,210 USD)[3] sending its waste to another state (Morelos) as an emergency solution. The governor had to quickly back down on its environmental contingency plan. Although the crisis lasted less than four full days and was swiftly resolved, this argument of unfairness in the attribution of environmental responsibility regularly emerges in environmental conflicts between the two states (for instance, see: Redacción (2016) in June 2016).

This example serves as an entry point to explore the complexity of Mexico City's environmental management: firstly, the physical and geographical features of the city make the provision and distribution of resources particularly challenging. Secondly, the metropolitan city spreads over a multitude of administrative entities (over sixty municipalities and three states). This means that although environmental problems extend beyond the city's administrative boundaries, environmental management and policy making takes place at the state level and without coordination between those entities. Cooperation is particularly difficult considering that Mexico City and the State of Mexico governments have been governed by opposed political parties since Mexico City's first democratic elections in 1997.

3.1.2 Informality in Mexico City's 20th century urban development

Spatial informality. Although the city is ancient and has always been one of the largest in the region in terms of population (the Aztec capital Tenochtitlan, located where Mexico City now

[3]Throughout the thesis, amounts in Mexican Pesos (MXN) are converted to US dollars (USD), as per the average exchange rate of 2015, year during which the fieldwork took place.

Figure 3.3: Front page of *La Jornada*, national newspaper, on 18 March, 2016

La Jornada

DIRECTORA GENERAL: CARMEN LIRA SAADE
DIRECTOR FUNDADOR: CARLOS PAYAN VELVER

VIERNES 18 DE MARZO DE 2016
CIUDAD DE MÉXICO • AÑO 32 • NÚMERO 11362 • www.jornada.unam.mx
10 PESOS

CRISIS POR LA BASURA

Las 13 estaciones de transferencia de desperdicios en la Ciudad de México no se dieron ayer abasto para recibir las cargas de los camiones recolectores, ante el cierre de tres confinamientos en el estado de México que había ordenado el miércoles el gobernador Eruviel Ávila por la contingencia ambiental ■ Foto Víctor Camacho

■ Ligera mejoría en la calidad del aire

Levantan la emergencia ambiental en el Valle de México

■ El anuncio, tras reunión de Pacchiano, de Semarnat, con Mancera y Eruviel Ávila

■ Crearán grupo de trabajo que en 15 días modifique el programa de contingencias

■ Se actualizará la verificación vehicular en todas las entidades de la megalópolis

BLANCA JUÁREZ Y ALEJANDRO CRUZ ■ 34

■ La recolección en la ciudad se colapsó ayer durante horas

Edomex reabre depósitos de desechos a la capital

■ Congestión de camiones recolectores en centros de transferencia

■ Morelos aceptó recibir desperdicios a cambio de $2 millones diarios

LAURA GÓMEZ, ALEJANDRO CRUZ Y RUBICELA MORELOS, CORRESPONSAL ■ 36

■ Fue decisión del gobierno capitalino

Rechaza la Corte haber ordenado circulación indiscriminada de autos

■ Tampoco se pidió modificar la verificación

■ El fallo sólo pretendía amparar a quejosos

JESÚS ARANDA ■ 39

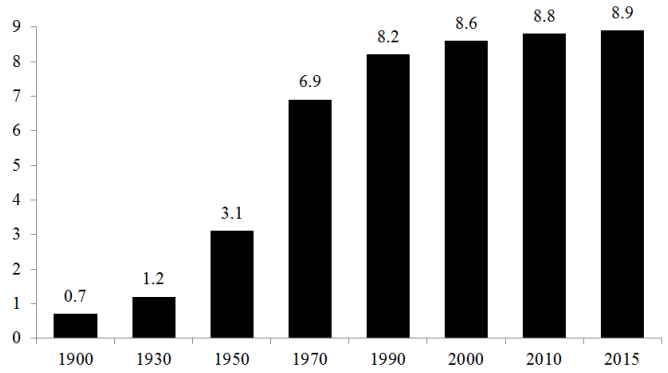
The main title states "Environmental contingency is lifted in Mexico Valley" followed by a subtitle "This was announced after a meeting between Pacchiano, from the Federal Ministry of the Environment and Natural Resources, Mancera and Eruvial Ávila [Mexico City and the State of Mexico's governors]". At the bottom of the page (boxed in red), one can read: "[The state of] Morelos accepted to receive waste in exchange for two million pesos daily".

Accessed online at: `http://www.jornada.unam.mx/2016/03/18/portada.pdf`

stands, had an estimated population of two hundred thousand in the 14th century), Mexico City experienced its most important growth in the 20th century: as Figure 3.4 shows, the population more than doubled between 1950 and 1970, with nearly four million new inhabitants in these two decades. This population growth reflects a national rural exodus that was triggered by a range of factors. First, the Mexican revolution of 1910-1917 saw the countryside turning into

battlefields, while Mexico City was relatively sheltered from the conflict. In the decades after the revolution, the government's national strategy for modernisation and economic development was organised around a national industrialisation plan, which consolidated urban centres as clusters of employment (Davis, 1994, Chapter 2). As Lomnitz argues, rural-urban migrations resulted from this policy, which on the one hand reduced investment in farming, leading to "agricultural stagnation and pauperization of the peasantry" (Adler Lomnitz, 1977, p.6), and on the other hand concentrated wealth, health and education services and jobs in the country's cities.

Figure 3.4: Mexico City's population 1900-2015, in million inhabitants



Source: INEGI (2010), through `http://cuentame.inegi.org.mx`

As workers and their families moved to the cities looking for jobs, they also needed housing, and access to the services necessary for urban life (food, water, electricity, sewage, transport). At the time, the government's industrialisation plan encouraged migration to the cities, yet its policy response in terms of service provision was lacking. In Mexico City, there was no official policy for housing provision, except one of repression of illegal settlements: in the 1960s, Mexico City's governor prohibited new settlements in the capital, and evicted many squatters to the periphery of the city (Platt, 2010). This started the process of urban sprawl towards distant peri-urban and rural zones which now make up the metropolitan area. In order to provide for their needs, urban dwellers had to organise themselves without the help of the state: they built their own houses on unused land. The lack of property rights, access to centralised services of electricity, water or sewage and construction licenses contributed to labelling these new neighbourhoods as *informal settlements*. The living conditions in informal settlements were dire; and perhaps more importantly, research has shown that living in those settlements maintained their residents in a state of poverty and marginality (Adler Lomnitz, 1977).[4] Still, this form of settling in the city was not marginal in numbers: the majority of housing making up

[4]This observation has also been made by Perlman (1980) in the case of Rio de Janeiro, Brasil.

the contemporary city was built informally, through dwellers' incremental building of their own houses on land they did not own (Platt, 2010), a trend that is observed more widely throughout Latin America (UN Habitat, 2011).

Economic informality. As the national industrialisation plan failed to provide as many jobs as originally predicted, unemployment rose in the 1970s (Platt, 2010). Combined with continued migration, this meant that informality also became the primary means to get a job - informal jobs would typically be in the service economy, and could be domestic work, creating a small business, craftsmanship, or street vending, among others. As of today, over half of Mexico's urban workforce is estimated to be informal (International Labour Office, 2013). This entrepreneurship of people opening their own business has also shaped Mexico City's formal economy, in which small businesses play a key part: small companies of five employees or less represent eighty-seven percent of all businesses in the city (INEGI, 2014).

Informal governance. The informal city could only take such importance in Mexico City because of the specific governance system ruling the city. This is the story told in the book *Urban Leviathan* (Davis, 1994): until 2015, Mexico City was the "Federal District", home of the country's capital. Being a city of national strategic importance, it was not considered a state, but rather governed directly by federal institutions (through a non-elected governor). This, according to Davis, means that the city's governance system was heavily influenced by the national single party, the Institutional Revolutionary Party (PRI for its Spanish initials) - which ruled the country between 1917 and 2000 - and its political practices. These practices include corporatism and clientelism, which were all the more prominent in Mexico City due to the absence of democratic structures. As a result, they developed as the main way to deal with different urban groups (for instance, informal settlements leaders, workers' trade unions or chambers of commerce), and enabled and supported the development of spatial and economic informality.

Corporatism and clientelism - informal politics in a Mexican Context

"**Clientelism** *involves asymmetric but mutually beneficial relationships of power and exchange [...] between individuals or groups of unequal standing [...]. Those in control -patrons, subpatrons, and brokers- provide selective access to goods and opportunities and place themselves or their supporters in positions from which they can divert resources and services in their favor. Their partners -clients- are expected to return their benefactors' help, politically and otherwise, by working for them at election times or boosting their*

patron's prestige and reputation [...]. In the political realm, [...] it entails votes and support given in exchange for jobs and other benefits." (Roniger, 2004, pp.353-354)

Clientelist politics is how informal settlements have grown and consolidated over the years (Varley, 1999). In order to access goods and services from which they are excluded, urban dwellers have had to resort to local civil servants, who take advantage of this mechanism of popular control, by applying the law to favour one or another urban group in a "discretionary and partial way" (Duhau and Giglia, 2008, p.509, own translation).

Looking at the case of street vendors and urban development in the historic centre of Mexico City, Silva Londoño explains that not only are informal street stalls tolerated by the state, informal street vendors are actually an important political actor in urban development. Contesting the traditional view of policy-making as a linear process under the sole control of state authorities, she rather qualifies this process as a "battlefield" where actions are the result of interactions between heterogeneous actors (including informal workers) who fight over the use and image of public space (Silva Londoño, 2010, p.222, own translation).

*"***Corporatism** *can be defined as a system of interest representation in which the constituent units are organized into a limited number of singular, compulsory, noncompetitive, hierarchically ordered and functionally differentiated categories, recognized or licensed (if not created) by the state and granted a deliberate representational monopoly within their respective categories in exchange for observing certain controls on their selection of leaders and articulation of demands and supports."* (Schmitter, 1974, pp.93-94)

Corporatism developed during the one-party rule established by the PRI to deal with trade unions at the national level. Mexico City's urban development was influenced by this system; and particularly urban services provision has been organised around a "class-based corporatist" system (Davis, 1994). Although this system has been challenged and weakened in the last two decades,* it has also outgrown the PRI and has been used by other governing parties, thus becoming a true "mode of urban management" (Duhau and Giglia, 2008, p.519, own translation).

One recent example of the legacy of corporatism in Mexico City is the case of public transport, and the creation of the first line of Bus Rapid Transit in the 2000s, which was in effect a formalisation of the bus service: the design of the new system had to be negotiated at every stage with the leaders of the informal groups who were hitherto running the

informal bus routes. Experts state that "the main challenge [of the BRT implementation process] was negotiating with the existing concessionaries along the projected corridors" (Centro de Transporte Sustentable A. C., 2009, p.117); negotiation which had to take place individually with each representative of the route associations (Lambarry Vilchis et al., 2011, p.147). According to Flores Dewey (2013), this negotiation turned to the advantage of the route associations as the government depended on their agreement to implement its project. This, in effect, left the local government with little leverage in comparison to the associations, at the negotiation table. As a result, the associations' demands were given priority over the requirements for the project's sustainability or financial stability; and more worryingly, the concessions granted to the old route associations are still perceived - in the operation stage - as a "right" which cannot be questioned based on performance or quality of service. The author concludes that the government set a precedent which makes it very difficult to change the nature of negotiations with other associations, for the implementations of future routes; thus lowering the probability of an integrated, accountable and regulated system in the future (Flores Dewey, 2013, pp.175-177).

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* See for instance Hernández-Medina's (2014) recent research, which describes an evolution from corporatism to pragmatism.

Although corporatism and clientelism are in no way specific to Mexico City or even Mexico, they appear as driving forces of the city's 20th century urban development and play a part in the formal planning system. *Corporatism* and *clientelism* are more generally defined, in the Mexican context, as the "particularist use of public resources" (Roniger, 2004, p.354), (Duhau and Giglia, 2008, p.517, own translation). While clientelism refers to sporadic relations between the state and individuals or groups of individuals, created around a particular negotiation rather than as a regular occurrence; corporatism deals with more regular relationships between the state and organised professional groups which are granted a monopoly in their sector. Both are characterised by corruption and the selective application of rules by civil servants.

Informal governance can therefore be understood, in the context of Mexico City, as the *normalised* selective application of formal rules of law, in which both informal workers and civil servants are involved; and which produces and maintains situations of economic and spatial informality. In this view, informal governance, which involves relationships of negotiation, collaboration and corruption between citizens and the government, is the other side of the coin of the informal economy. The development of informality through the daily provision of ser-

vices cannot be disassociated from the development of informal forms of governance: urban dwellers needed the state to provide services and secure those already provided informally, giving them legitimacy (for instance, giving land tenure in informal settlements). As Adler Lomnitz (1988) has shown, the networks of reciprocity, corruption and patron-client relations that have developed between urban groups and the state are those which have enabled and consolidated informal activities (settling, working, exchanging) in the city:

"The degree of formality and the inability of the formal system to satisfy societal needs give rise to informal solutions. If the formal system is able to produce and distribute the goods and services required by all members of society, informal solutions would be less needed and thus less pervasive." (Adler Lomnitz, 1988, p.13)

In her work, Adler Lomnitz goes further, and argues that these relationships can be found not only in the consolidation of informal activities, but in any political interaction, even within the formal system: for instance, a formal business might resort to corruption in order to ease its activity (to speed up a bureaucratic process in relation to its activity). In this sense, informal relations act as a "support system" to formal regulations, as they smooth processes where the formal fails to be efficient. This might also mean that these practices are used to further private interests within urban politics.

The phenomena of clientelism and corporatism are by no means the only analytical concepts that can explain urban management in Mexico City.[5] Rather, the intention here is to use them as concepts that help contextualise the case study. This is for two main reasons: firstly, they appear to be intricately related to the lasting character of informal economy in the city. They also play a role in waste management and its governance, as will be shown in the next section. Therefore, although the focus of the research is waste handling within the informal economy, it is crucial to understand the mechanisms of informal governance within which those activities are embedded.

3.2 Mexico City's waste management system

Waste management represents as much of an environmental as a political challenge for Mexico City's government: disposing of waste in a safe way is a public health imperative, and impacts directly on the amount of greenhouse gas emissions the city produces. GHG emissions related to waste account for fourteen percent of the city's total emissions (excluding the emissions associated with the transport of waste) (SEDEMA, 2014). In addition, Mexico City is dependent on its neighbouring states (State of Mexico and Morelos) to dispose of its waste, in sanitary

[5] See for instance, Brachet-Márquez (1998) who proposes pluralism and class as two complementary perspectives.

landfills owned by private companies. This has been used as political leverage in the past by the governments of these two states, as shown in the previous section. This section first describes waste flows (waste generation and management), then moves on to waste governance, and finally concludes with the formulation of a research topic based on the findings regarding the interaction of informality with waste management in Mexico City.

3.2.1 Waste flows

Waste generation and composition. Every day, Mexico City's households and businesses produce 12,893 tons of solid waste (SEDEMA, 2015).[6] This represents around 1.5 kg per inhabitant daily, above the world average of 1.2 (Hoornweg and Bhada-Tata, 2012). There is no data available at the metropolitan level, although it is known that the whole State of Mexico (which includes two other major cities, Toluca and Santiago Tianguistenco) generates 8,285 tons of domestic waste daily (INEGI, 2013b).

Waste composition is presented in Table 3.1.[7] Organic waste represents nearly half of the total waste produced, and another twenty-seven percent is shown to be potentially recyclable. This means that less than a quarter of the total waste produced cannot be recovered - using existing technologies or techniques.

Table 3.1: Waste composition in Mexico City, in percentage of total waste generation

Waste material	Percentage of total waste
Materials with recyclable potential	**27.2**
Plastics	13.2
Cardboard	4.0
Paper	5.9
Glass	2.7
Ferrous metals	1.2
Non ferrous metals	0.3
Organic waste	**49.5**
Non-recyclable waste	**23.3**
Total	**100**

Source: Adapted from (Duran Moreno et al., 2013)

[6]This figure is excluding construction waste, which could add another 59 tons a day (SEDEMA, 2015), and industrial waste, for which there is no available estimation. This is also excluding domestic waste which is collected informally and never reaches the governmental waste management infrastructure. The national statistics agency independently reports a higher figure of 17,043 tons per day (also excluding industrial and construction waste) INEGI (2013a).

[7]This data has been calculated by Duran Moreno et al. (2013) based on a one-off analysis of waste samples taken at governmental waste management sites. It is the only estimate of waste composition for Mexico City published in either academic or the grey literature which includes a detailed and robust discussion of methods. Mexico City's Waste Management Programme (SEDEMA, 2016) reports the following waste composition: 44% organic waste, 35% recyclable waste, 21% non-recoverable waste - with no discussion of methods.

Waste flows and government infrastructure for waste management. Let us describe how domestic waste management works - in theory - according to the infrastructure put in place by Mexico City's government and the municipalities of the city (this is summarised in Figure 3.5). The waste that is generated in Mexico City is collected daily by municipal employees (garbage-men, street sweepers and drivers of the waste collection trucks). The municipal team drives slowly through the streets while ringing a bell (this process is called *toque de campana*, or 'bell ringing' in English).[8] Upon hearing the bell, citizens come out with their daily waste, and deposit it in the truck. In the case of working households (who might be away from home during the day), the building administrator, the household's cleaning staff, or potentially a neighbour, would usually carry out this task. It is customary to tip municipal employees, daily or weekly, when depositing waste.[9]

In the best-case scenario, waste collection trucks are equipped with two separate containers, one for organic and the other for non-organic waste; and they receive waste that is well separated by households (according to law, Mexico City residents are expected to separate their organic from inorganic waste). In other cases, non-organic and organic wastes are collected mixed. Households are not advised (let alone obligated) to separate recyclable materials. Once the collection truck finishes its route, the waste is first transported to one of the Municipal Transfer Centres. There are thirteen Municipal Transfer Centres in Mexico City (nearly one per municipality); these gather waste from the different municipal waste collection routes, and fill trailers of organic and non-organic waste. Mexico City has a programme to separate organic material from domestic waste, and to transform it into compost on various composting sites throughout the city (see Figure 3.6). Only the organic waste which is of sufficient quality to produce compost, and which is well separated from non-organic materials (for instance, plastic bags), is sent to composting sites throughout the city.

Part of the waste received in the Municipal Transfer Centre does not directly go to landfill; mixed waste which is estimated to be rich in recyclable materials is taken instead to one of the city's two Waste Selection Plants. Both of Mexico City's waste selection plants are managed by organised groups of informal waste-pickers, over which the government has no control. These groups separate recyclable from non recyclable waste. They keep the recyclable material (one can assume they sell it to the recycling industry, although there is no data confirming this),

[8] A glossary of Mexican Spanish terms and expressions is provided in Appendix A.

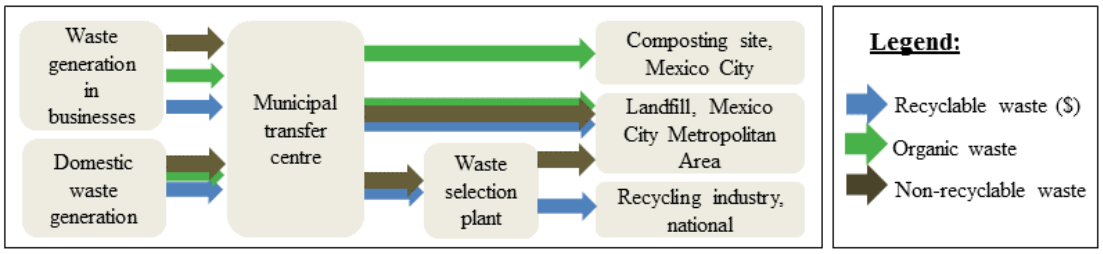
[9] I did not collect data on these tips; however, a study reveals that in the State of Mexico (neighbouring Mexico City), households tip the municipal waste collection team 8 pesos per week on average (0.48 USD) (Centro Mario Molina, 2015).

while the non-recyclable waste is sent to one of Mexico City's landfills. There is no robust data regarding the rate of recovery (although in the waste inventory, this is estimated at 10%) (SEDEMA, 2015) - or where the materials are sold and recycled.

Back to the Municipal Transfer Centre, the waste that is neither organic, nor of sufficient potential to be sent to the waste selection plant; is sent directly to landfill and is generally buried. These landfills are located outside of Mexico City (see Figure 3.6), and are owned by private companies who charge for receiving waste by weight.

In addition, waste generated by businesses is collected (regularly or as a one off service) by the City government in exchange for a fee. In order to be collected, the waste has to be well separated. The waste thus collected then follows the same path (through the municipal transfer centre). This description of waste flows, based on the governmental waste inventory (SEDEMA, 2015) is represented in Figure 3.5. The physical location of the government infrastructure is presented in Figure 3.6, and an example for the waste flows produced in Tepito is presented in Figure 3.7.

Figure 3.5: Domestic waste flows through Mexico City's governmental infrastructure

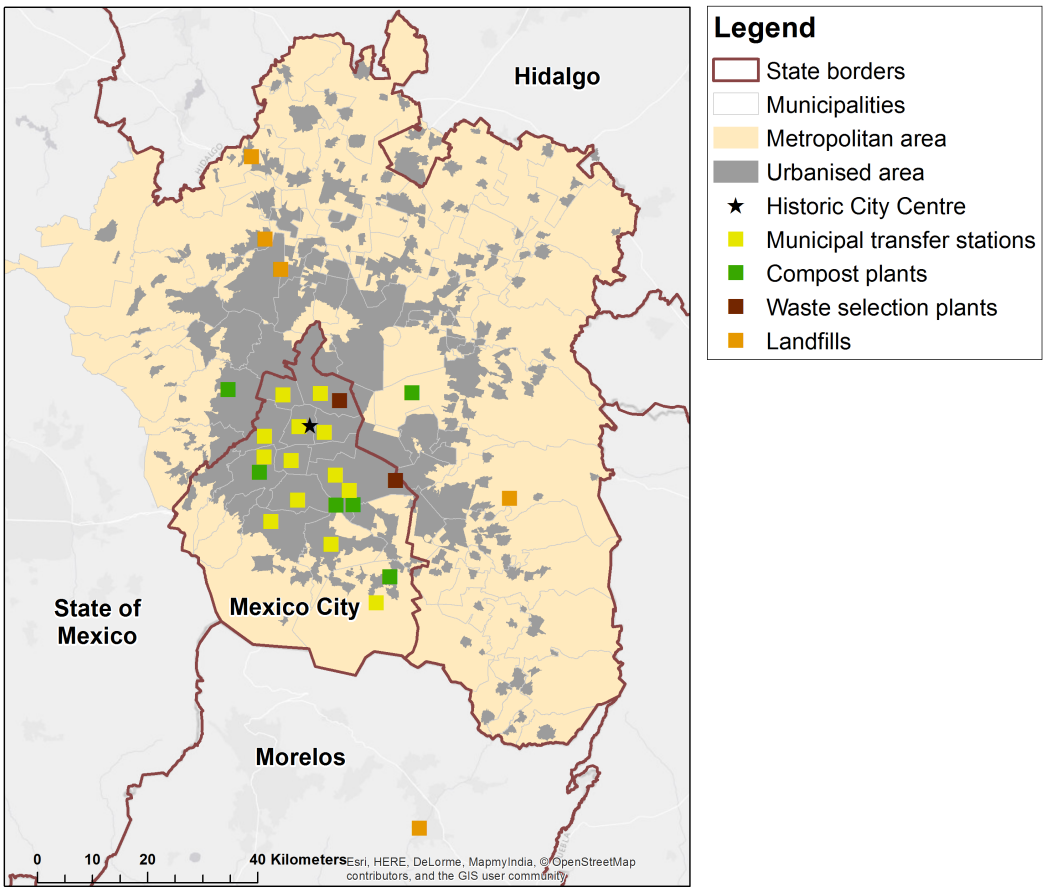


Source: Own elaboration, based on (SEDEMA, 2015)

Non-governmental waste handlers. The previous diagram only mentions the municipal and city wide governmental infrastructure and service provision regarding waste. However, this is only one part of the story: there are other actors participating in waste management which have not been mentioned so far.

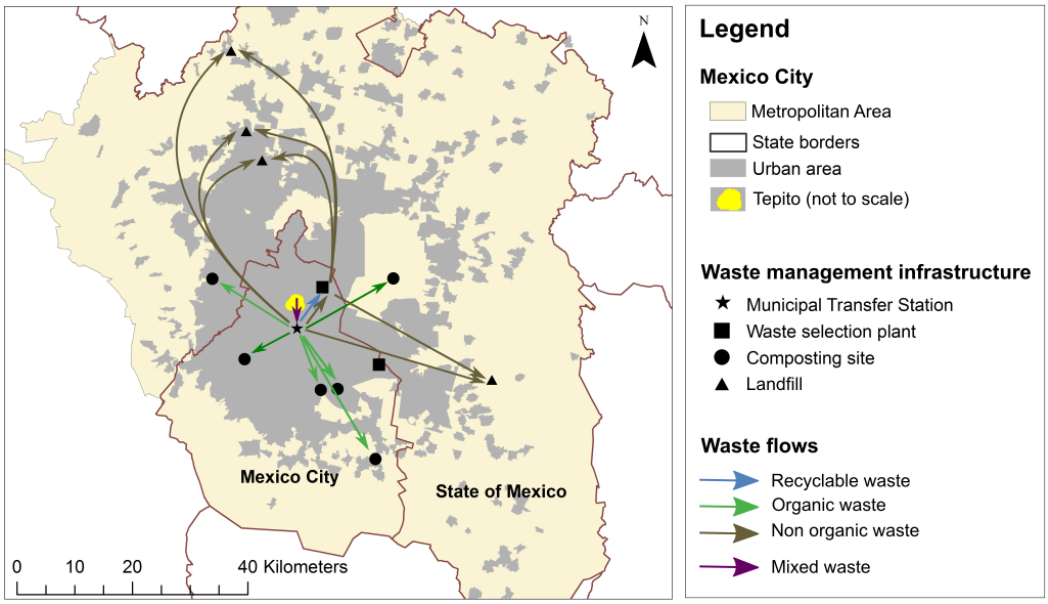
One is the private sector: although Mexico City's municipality cannot legally grant concessions to private companies to run the waste collection service, the private sector does play a role in collecting waste in certain cases. Particularly, private companies are hired to manage hazardous waste (their work is regulated and closely monitored by the Ministry of the Environment) - although considering this is not domestic waste, this is not part of this research. In addition, private companies can provide waste collection and management services to private entities for a fee; usually providing a higher quality service than the municipal collection service. Their clients tend to be high waste generators, such as shopping centres or gated communities (in these cases, the waste produced is still categorised as domestic waste).

Figure 3.6: Location of key waste infrastructure in Mexico City's metropolitan area



Source: Own elaboration

Figure 3.7: Flows of Tepito's domestic waste through the governmental infrastructure



Source: Own elaboration, adapted from (Guibrunet et al., 2016)

Another example relates to schools and hospital. In each case, waste has to be disposed of in a sanitary way, at a very specific time each day (this is particularly crucial in schools, in order to avoid the interaction between cleaning staff and children). As a result, it is more convenient for these establishments to hire a private company to collect waste, in order to ensure waste will be collected to the standard required. The private companies use collection trucks which they are allowed to empty in landfills, in exchange for a fee. There is no data publicly available on the amount of waste collected in this way or the number of companies providing this service in Mexico City. According to an expert, the proportion of waste handled this way throughout Mexico City is "minimal" (Cit6, July 2016).

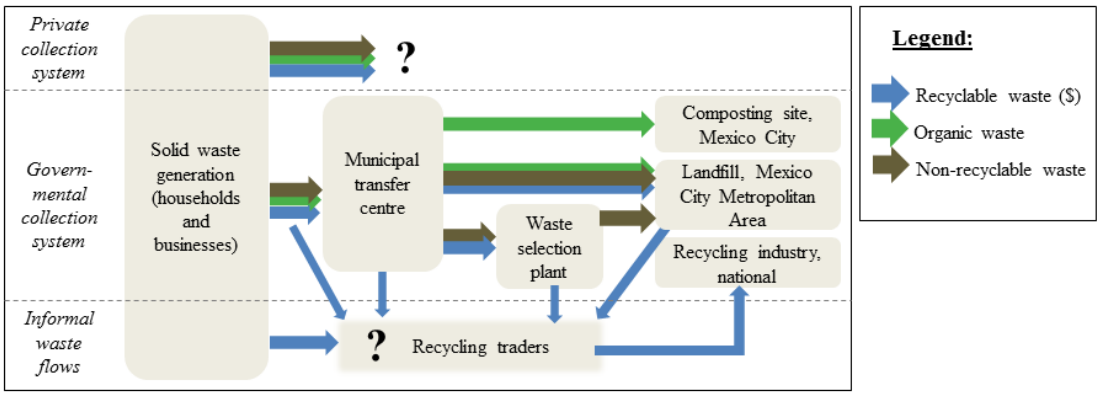
The other important group of non-governmental actors is that of informal waste handlers. The phrase "informal waste handlers" refers to those individuals whose work involves waste management very generally, this can be picking, collecting, separating, transporting, processing or trading domestic waste. They are not hired by the state, and perform these activities independently from governmental programmes of waste management. Additionally, they work in an economic structure which does not comply with legal, environmental or labour regulations, and which is not registered with the tax office - they are part of the informal economy as defined in this research.

The existence of these workers in the context of Mexico has been described in the literature: the most commonly referred to are the informal waste-pickers, called *pepenadores* in Mexican Spanish (this comes from the indigenous Nahuatl language: 'person who picks things up'). Waste-pickers extract valuable materials from domestic waste. These can be recyclable materials, but also objects and products that can be re-used (for instance, empty cosmetic bottles are sold to be re-filled, rather than recycled). Food waste can also be selected, either to eat, or to sell as animal feed. Waste-pickers work at every stage of the waste management chain: in buildings, before the domestic waste is thrown away, on the waste collection truck, at every government facility (the Municipal Transfer Centres and the Waste Selection Plants) and on the landfills. The waste-pickers then sell the material they have gathered to recycling traders (which could be formal or informal); who then sell these materials to the (formal) recycling industry (Castillo Berthier, 1984; Medina, 2000; Buenrostro and Bocco, 2003).

Figure 3.8 represents the waste flows that have been described in this section - those from the private sector, and within the informal economy, which complement the flows through the governmental infrastructure (referred to as the "governmental collection system" in the diagram). This diagram is also helpful in understanding what is not yet known about waste flows through Mexico City. Two big unknowns are, first, what happens to the waste collected by pri-

vate companies; and second, how recyclable waste managed informally reaches the recycling industry. It is this second unknown that this research focuses on.

Figure 3.8: Diagram of flows of domestic waste in Mexico City - the state of knowledge



Source: Own elaboration

3.2.2 Waste governance

Governmental institutions. Waste management responsibilities are shared among the three levels of the Mexican government (federal, state and municipal). The federal level is not involved in waste management operations; mainly, it sets the legal responsibilities and environmental standards (such as emissions thresholds) that have to be respected at the local level. The state level is where most of the power lies in terms of logistics and strategies: in Mexico City, the Ministry of the Environment is in charge of the overall strategy of waste management (particularly, implementing the solid waste management programmes), and setting the standards regulating the different waste management operations (such as those of private waste collection companies). On the other hand, the Ministry of Urban Services and Public Works is in charge of the waste management infrastructure (the Municipal Transfer Centre, composting sites, waste selection plants and landfills), and generally the logistics of waste management in the city.

The municipalities are in charge of the services of street cleaning and domestic waste collection, and transport of the waste to the Municipal Transfer Centres. Once it arrives at the municipal transfer centre, waste and its management become the responsibility of Mexico City's government (rather than the municipality). In Mexico City, the municipalities are not allowed to grant concessions to private companies to provide this service; they have to manage it with their own employees, resources and infrastructure.

Syndicate. All of Mexico City's government workers are members of the Unique Trade Union for Mexico City Government Workers (*Sindicato Único de Trabajadores del Gobierno de la*

Ciudad de México),[10] a legacy of twentieth century corporatist politics (Castillo Berthier, 2003). Waste workers are grouped within Section 1 - 'Cleaning and Transport' - which represents approximately 18,500 workers (ibid).

The workers' representative is in charge of negotiating the rights and working conditions of all formal waste workers employed by the government. The existence of a single organisation representing all of the city's waste workers, built under corporatist principles, gives it power to influence the design and implementation of policies. The government has to negotiate any change in the waste management system with the trade union. Given that negotiations happen behind closed doors and without accountability, the union is routinely accused of corruption (see for instance: Montes de Oca (2014)).

Informal governance - organised groups and the *cacique* system. The trade union only represents those workers who are employed by the Mexico City government and municipalities (street sweepers, collection truck drivers, waste collectors, workers on the Municipal Transfer Centre and other government infrastructure). It does not represent informal workers - this begs the following questions: how do informal waste handlers and civil servants interact? What is the space where informal and institutional actors meet, to discuss the operation of the waste management system?

There is no academic research that completely answers this question. One piece of the puzzle is Castillo Berthier's 1984 anthropological research among waste-pickers working in one of Mexico City's emblematic landfills, *Santa Cruz Meyehualco*. This research describes a social structure that brings into existence the "biggest and most powerful urban cacique system in Mexico" (Castillo Berthier, 1984, in introduction, own translation). In this context, the word *cacique* is used to describe "an individual exercising an exclusive influence in local politics", who is the only mediator between workers and the state, and who exerts an autocratic, informal and violent power (Castillo Berthier, 1984, in introduction).

Castillo explains that more than forty thousand families live and work on Mexico City's landfills - in dire conditions -, and are all under the rule of a single leader. This leader, the *cacique*, ensures a continued livelihood for those workers (finding new spaces to work when a landfill closes down) and provides them with housing and services (including educational, health, religious and entertainment), becoming "almost a god" (Castillo Berthier, 1984, in introduction, own translation). This *cacique* is a well-known character in Mexico City, and is but one of the stories which make up the collective imaginary around waste management. As an essayist and journalist puts it:

[10] See: `http://sutgdf.wixsite.com/sindicato-unico`

"Garbage has become an obsession for the inhabitants of Mexico City, spawning any number of fantastic stories, all of them true. There is, for example, the story of open-air garbage dumps that spontaneously ignited one day in July, spreading fire and toxic fumes over acres of refuse stacked twenty yards high. There is the story of the cacique who controlled more than half the city's seventeen thousand-odd pepenadores, or garbage pickers, demanded sexual favors from the garbage pickers' daughters, and also took all his workers off to Acapulco on vacation once a year. There is the story of a sixty-square mile garbage dump that the city government decided to turn into a park, complete with picnic tables - tables that have since been sinking gently into the settling layers of trash and loam." (Guillermoprieto, 2004, p.291)

These stories are well known and commonly referred to in the waste management debate. To what extent do they reflect the realities of contemporary waste management? Castillo's research was undertaken in the 1980s, and the situation has evolved since. Most of the landfills he describes have been closed (one exception is *Bordo Xochiaca*, still inhabited by waste-pickers). One of the legacies of the *cacique* system is the creation of the Waste Selection Plants, offered by the government as a place to re-locate groups of informal waste-pickers when the landfills closed. The two Waste Selection Plants presented in Figure 3.5 were built by the Mexico City government, but they are under the complete control of groups of informal waste-pickers which still reproduce the *cacique* system (Castillo Berthier, 2003). Thus, *caciquism* makes up, to this day, part of the governance system of Mexico City's waste management. On the other hand, there is no account of research which would attempt either to corroborate or to contrast Castillo's findings in recent years. Therefore, the extent to which this account of *caciquism* reflects the diverse realities of contemporary waste management remains to be assessed.

Legal documents. There is a wide range of legal documents governing waste management in Mexico, and in Mexico City particularly. The main one at the national level is the *General Law for Waste Prevention and Integral Management*. At the urban level, the *Law of Solid Waste* is the document which sets the rules for urban waste management, and particularly, the annual publication of a waste inventory (in the form of an urban-wide, quantified solid waste flows diagram), and the periodic production of a *Integral Solid Waste Management Programme*. These responsibilities and legal documents are summarised in Table 3.2. Indirectly, the different climate documents (*Law of Climate Change Mitigation, Adaptation and Sustainable Development*; and Mexico City's *Climate Action Plan*) also influence the waste strategy, particularly by defining emissions thresholds for waste management and disposal processes.

Table 3.2: Legal responsibilities of waste management

Level of government	Responsibilities	Legal documents
Federal government	Set environmental standards and legal responsibilities	General Law for Waste Prevention and Integral Management
Mexico City government	Produce a waste management strategy, set operation standards, manage the infrastructure, dispose of waste	Law of Solid Waste ; Integral Solid Waste Management Programme
Municipalities	Clean the street, provide domestic waste collection service and transport waste to the government infrastructure	

Source: Own elaboration

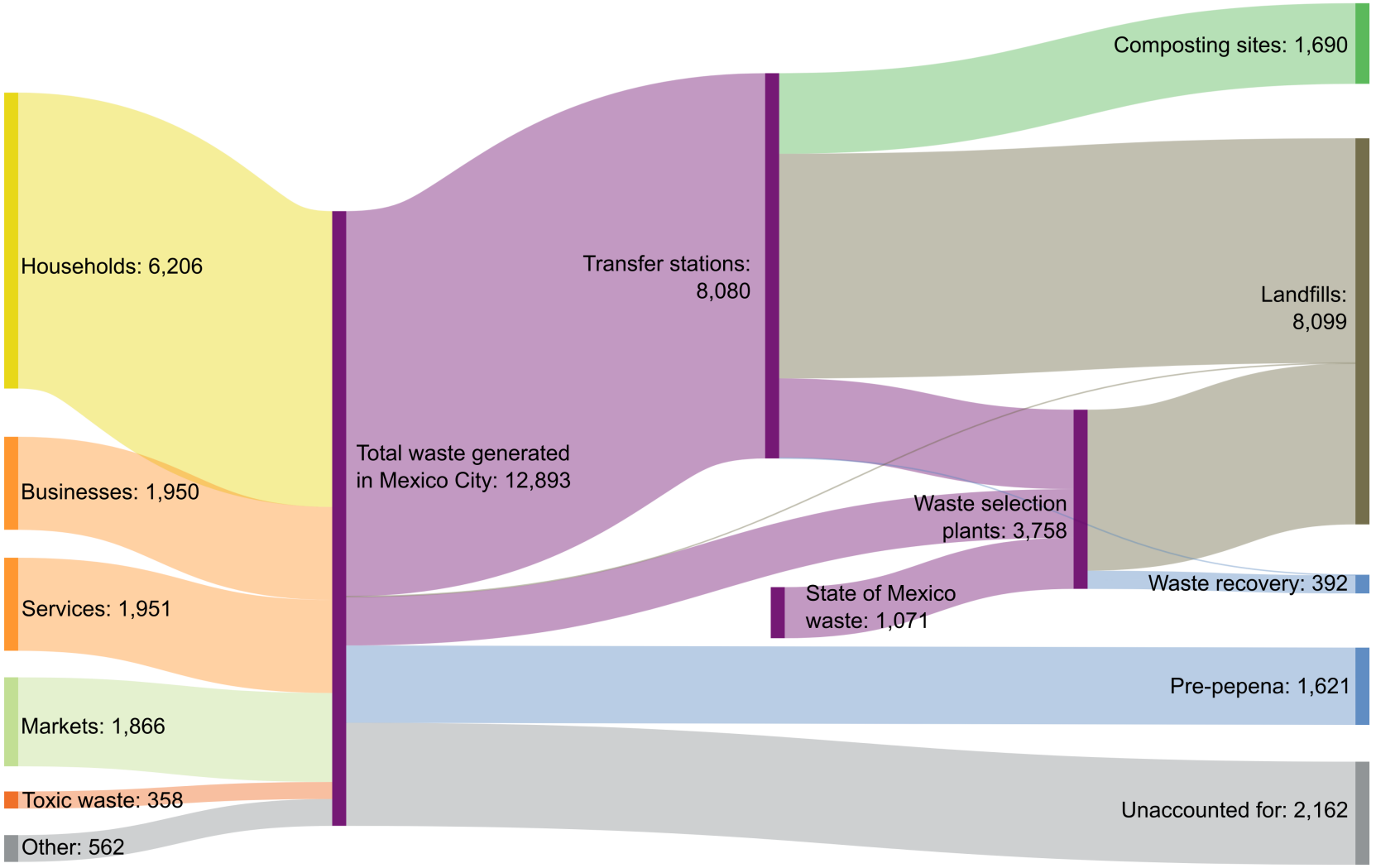
Waste management strategies - the 2016 waste management programme. The document which sets the strategy for urban waste management is the *2016-2020 Integral Solid Waste Management Programme for Mexico City* (SEDEMA, 2016) (it is commonly referred to as the "Zero Waste Plan" by the government and the media). The document outlines principles and guidelines to achieve the stated objective of "minimising the quantity of waste being sent to landfill". Different aspects of waste management are covered (waste prevention, waste transport, waste recovery, landfill), with in each case, policy tools to enhance waste recovery and reduce waste disposal. The focus of the previous plan (Gobierno del Distrito Federal, 2010) was the improved management of organic waste through composting (achieved by creating composting infrastructures, and promoting organic waste separation in the household). In this plan, options such as enhanced recycling and waste-to-energy programmes are considered.

The programme is based on a diagnostic of waste generation and composition (which is updated and published every year as a "waste inventory"). The 2015 waste inventory (SEDEMA, 2015) is the one used in the Programme.[11] Figure 3.9 is a Sankey diagram which represents a simplified version of the 2015 waste inventory. As Figure 3.9 shows, the focus of the waste inventory is the solid waste which is managed through the government urban waste collection and management infrastructure. Particularly, the diagram shows two waste flows that represent a diversion from landfill: organic waste going to composting sites, and waste recovery (recycling and waste-to-energy programmes). These are managed by the government: the composting sites are publicly owned, and the waste-to-energy programme is the result of a negotiation between the government and the main cement company, CEMEX. Through these channels, the public waste management system achieves a nineteen percent rate of diversion from landfill.[12]

[11] This is the document on which the simplified diagram of flows of domestic waste (Figure 3.5) is based.

[12] This figure is based on the amount of waste that is re-purposed through composting (1,690) or recycling schemes (392) divided by the amount of waste being produced by shops and households which is collected by the municipality (12,893-2,162). The flow labelled "unaccounted for" is excluded from the calculation.

Figure 3.9: Sankey diagram of Mexico City's domestic waste flows, in tons/day



Source: Adapted from the official waste inventory (SEDEMA, 2015)

By comparing the waste composition data presented in Table 3.1, to the waste inventory (Figure 3.9) - and particularly those flows which represent a diversion from landfill -, we gain an insight into the efficiency of Mexico City's waste recovery strategies: first, we observe that although 49.5% of the waste produced is organic (Duran Moreno et al., 2013), less than a third of this organic waste is sent to composting stations (SEDEMA, 2015). In parallel, 27.8% of waste is potentially recyclable (see Figure 3.1), yet according to the waste inventory (Figure 3.9), only 392 tons (10% of the potentially recyclable waste, or 3% of total waste) is actually recycled.[13]

As suggested earlier in Section 3.2.1, the waste inventory (and therefore the official dataset) excludes various non-governmental (informal and private sector) waste flows. Informal recycling appears only once in the diagram, in the form of the "pre-pepena" which refers to waste-picking taking place on the collection truck (performed by the municipal garbage-men), during the transport from the Municipal Transfer Centre to the Waste Selection Plant.

However, there is no further explanation about what this process of *pre-pepena* entails, an acknowledgment that it is also carried out by informal actors, nor - perhaps more importantly - an analysis of the contribution of these actors to the system and how this contribution could be built on and improved. The existence of a *pepena* occurring *before* waste collection is also overlooked.

3.3 Informal waste handling in Mexico City - formulation of a research topic

The previous section has presented the state of waste management in Mexico City, and insisted on the following paradox: although the existence of informal waste-pickers and recycling traders is undeniable, and has been pointed to in the literature, their working conditions, contribution to the system and their relationship with other waste workers have not yet been explored in the context of Mexico City. Governmental databases and strategies overlook the role of informal waste handlers and focus on policy-making affecting their own employees and potential collaboration with the private sector.

In terms of governance, we can observe that the waste governance system is at least partly based on practices of informal politics: on the one hand, civil servants negotiate and cooperate with formal employees through their representative at the unique trade union, of which all workers are automatically members - this fits a model of urban corporatism. On the other

[13] The waste composition data is based on samples taken at the Municipal Transfer Centre, and thus excludes the recyclables separated on the truck before it reaches the Municipal Transfer Centre (the *pre-pepena*).

hand, some informal waste-pickers are (or were) represented by a single autocratic *cacique* who negotiates directly with civil servants. This model is similar to one of clientelism.

Yet, the *cacique* system was identified in the 1980s in the particular context of waste-pickers living in landfills. This model is not necessarily the best suited to represent the contemporary cooperation and communication between informal waste workers and civil servants. This model might have evolved since the 1980s, particularly as Mexico City opened up to democratic representation, weakening the PRI's political power (Davis, 1994). In addition, informal waste handlers' working conditions are very diverse (Buenrostro and Bocco, 2003; Medina, 2005): many of them are not waste-pickers (for instance, recycling traders), they do not live on the landfills and are not ruled by the *cacique* system. Little is known about the interaction of these actors, among themselves and with their formal counterparts.

This is the topic of this research. The thesis intends to address the research gaps of the diversity of waste handlers in urban Mexico, and of their contribution to waste management. How do they participate in waste management? How do they interact with formal waste handlers (that is to say, the garbage-men)? How are they integrated in the governance system? In order to answer these questions, the case of one neighbourhood is studied. The case chosen is Tepito, and is presented in the following section.

3.4 Tepito as a case-study neighbourhood

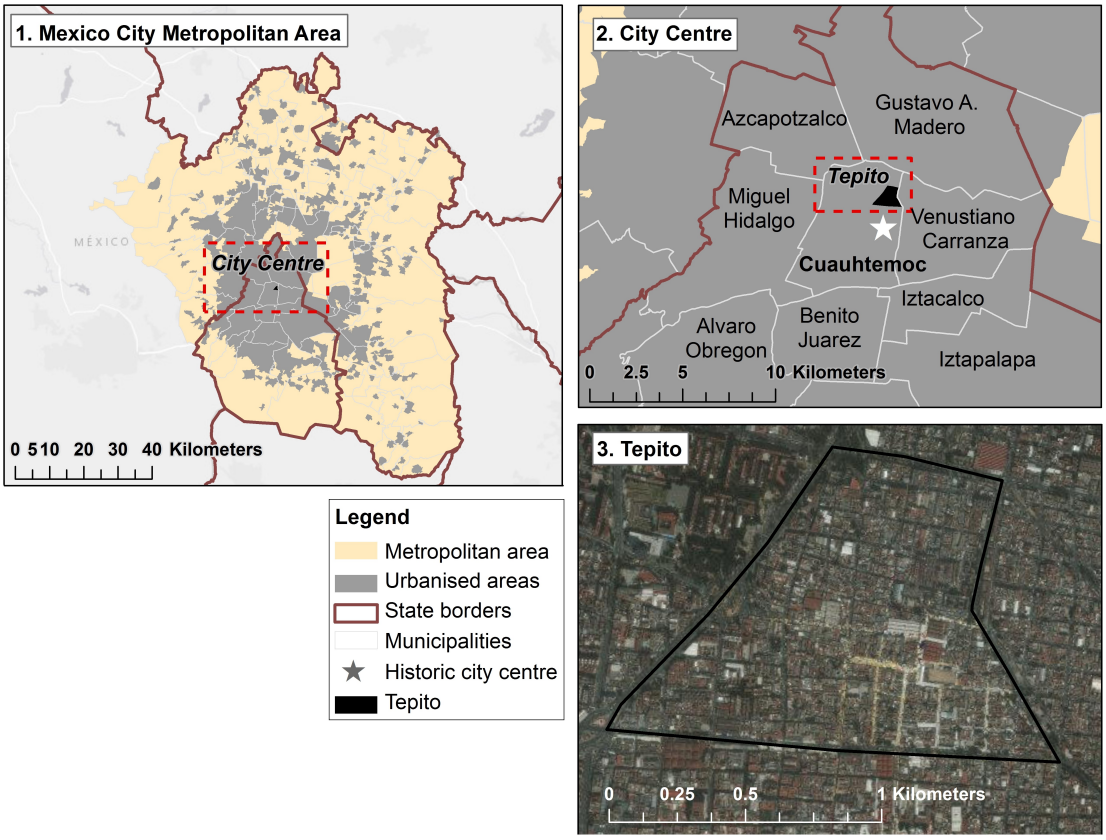
In the Mexican collective imagination, Tepito is a quintessential informal neighbourhood. Tepito is a pre-Hispanic settlement located in the city centre. It has been populated over the centuries by waves of immigrations of poor rural families from different parts of the country. As migrants would arrive in Tepito to settle and to work, the neighbourhood concentrated informal subsistence activities. Migrants brought their regional crafts with them, and worked mainly in the production, reparation and sale of everyday necessities and second-hand goods. They would work from their home or in public spaces, and many of them would sell what they were producing directly on the street, which developed as a market, catering for the lower-income class of the city. Historically, Tepito is where the urban poor would come to buy or barter everyday necessities such as clothing, food, tools for work. In later decades, other activities developed, such as making imitations of exclusive brands' products, and piracy. Today, Tepito is home to an incredibly diverse range of informal markets, where people come from all over the city to buy clothing and shoes, pirated music and films, electronics, cosmetics, and many other goods, at a much lower price than in formal shops.

Tepito is a neighbourhood which epitomises urban informality: urban dwellers arrived to Tepito because they knew they would find a job and housing (albeit informal). As such, they have rarely relied on the government for support. This may explain why over time, residents organised to regulate the daily life in the neighbourhood: in some of Tepito's streets, taxes are paid to informal leaders rather than the state, who are in charge of providing urban services (from security/policing, to waste management, citizens' advice, working permits, health services, among others). In this section, I present the case of Tepito, looking particularly at the development of the informal markets in the neighbourhood, and at the informal governance system developed to govern them. I argue that the density and diversity of informal activities in Tepito makes it an excellent case to explore the role of informality in waste management.

3.4.1 Localisation of Tepito

Tepito is a small neighbourhood (just over 1km^2) located in the core of Mexico City, a few blocks away from the historic city centre (see Figure 3.10). Tepito is inhabited by 35,886 urban dwellers (10,212 households) as of the latest census (INEGI, 2010).

Figure 3.10: The neighbourhood of Tepito in Mexico City



Source: Own elaboration, 2016 - with GIS data from INEGI and Google Earth

3.4.2 Daily life in Tepito: street markets and residential areas

The development of Tepito's street markets. In the last fifty years, Tepito's economy moved away from craftsmanship to commercial activities. The city's economy, following a global trend, was increasingly led by the service industry. In Tepito, this transition was intensified by external forces: as Hernandez and Cross (2006) explain, architectural programmes were put in place by the local government (and pushed for by the World Bank) to improve housing quality and increase density. While tenement houses are the traditional architectural type,[14] new constructions have favoured medium rise buildings, with less common space. As a result, the productive activities that up to then had been carried out in the patios, had to take place on the street. This contributed to the transition from a crafts economy to a trading one, for which the streets seemed more adequate.

The neighbourhood counts 1,200 formal shops and 12,000 informal stalls in the street. An additional 1,500 stalls are set up for the Sunday clothes market (Sanchez Valverde, 2009). Tepito is famous for its clothing markets, some taking place weekly (such as La Lagunilla), others daily (such as Calle Aztecas). Another street boasts warehouses where antique furniture can be bought and repaired. On the main streets, electronics are traded at a lower price than in official shops, as well as cosmetics, CDs, second-hand items, toys and many other goods. These come from different places; some coming from Mexico City and others as far as China. Although the markets still cater for the urban poor, their success means that most vendors now belong to the city's middle class - although very little is known about the actual income of workers in informal markets.[15]

Spatial organisation of the neighbourhood. The commercial and residential uses of the space coexist in the neighbourhood. The northern and western parts of the neighbourhood are mainly residential (although the ground floor of buildings would be used by shops in primary roads). The main housing type are tenement houses and medium-rise buildings. In the south-eastern

[14] *Vecindades* are a traditional Mexican type of tenement housing in buildings of two or three storeys organised around common patios.

[15] The information that can be gathered among local vendors is quite contradictory. On the one hand, street vendors present themselves as a poor and vulnerable community. They argue that because they lack resources or education, selling informally is their only way of earning a living (that is, by legal means). They justify their informal status (which includes appropriating the street for private benefit, and not paying taxes) by this lack of alternatives they face, as well as by the very low income they earn. On the other hand, some workers proudly explain that Tepito vendors often earn more than a qualified professional working in an office. Many of them show off their wealth with expensive clothing and cars, or talking about their trips abroad. It is said that stalls in the market streets of Tepito are rented and sold for a fortune - this could lead to a wealth gap between renters and owners of selling spaces which explains the competing accounts of poverty and wealth of Tepito's workers. A phenomenon can even be observed, where local traders that can afford to, move out of Tepito into middle class neighbourhoods, and use their former house as storage space for their business. As a result, population density has decreased in the neighbourhood and commercial uses of the space have taken over residential uses, although this is not registered in governmental land-use plans. It is estimated that only one in four street vendors in Tepito lives in the neighbourhood (Sanchez Valverde, 2009).

part of the neighbourhood, the markets are set up in the street along residential buildings - this means that in every street, commercial and residential activities take place alongside each other, although one land-use is generally dominant over the other.

The following photos illustrate these two main activities in Tepito: Figure 3.11 shows the markets seen from above, the yellow patches being the plastic roofs of the semi-permanent structures of the market stalls. The photo illustrates how these structures take up the whole streets and public spaces around the buildings, rendering access by vehicles impossible. Figure 3.12 shows a usual sight within the market, where many different activities coexist (here, selling clothes and eating lunch). In contrast, Figure 3.13 shows the view from a residential street, outside of the market area.

It is important to note that Tepito's land use differs from the one defined in the local land-use map designed by the municipality (reproduced in Figure 3.14). Although the planned land use is primarily residential (apart from the public markets and two main commercial zones), the reality differs. By walking in the streets of the neighbourhood one can easily observe the primacy of commercial uses of space, with the street and pavements being used as the main ground for economic activities. This is especially true in the southern part of the neighbourhood, where the markets and stalls are concentrated. Therefore, the actual land use differs from the planned one; the actual land use is represented in Figure 3.15 (based on my observations in the neighbourhood) - this reflects the informal economy of the neighbourhood which does not follow the local regulations of the municipality.

Figure 3.11: Tepito's markets, seen from above

Credits: Alfonso Hernández Hernández, Centro de Estudio Tepiteños

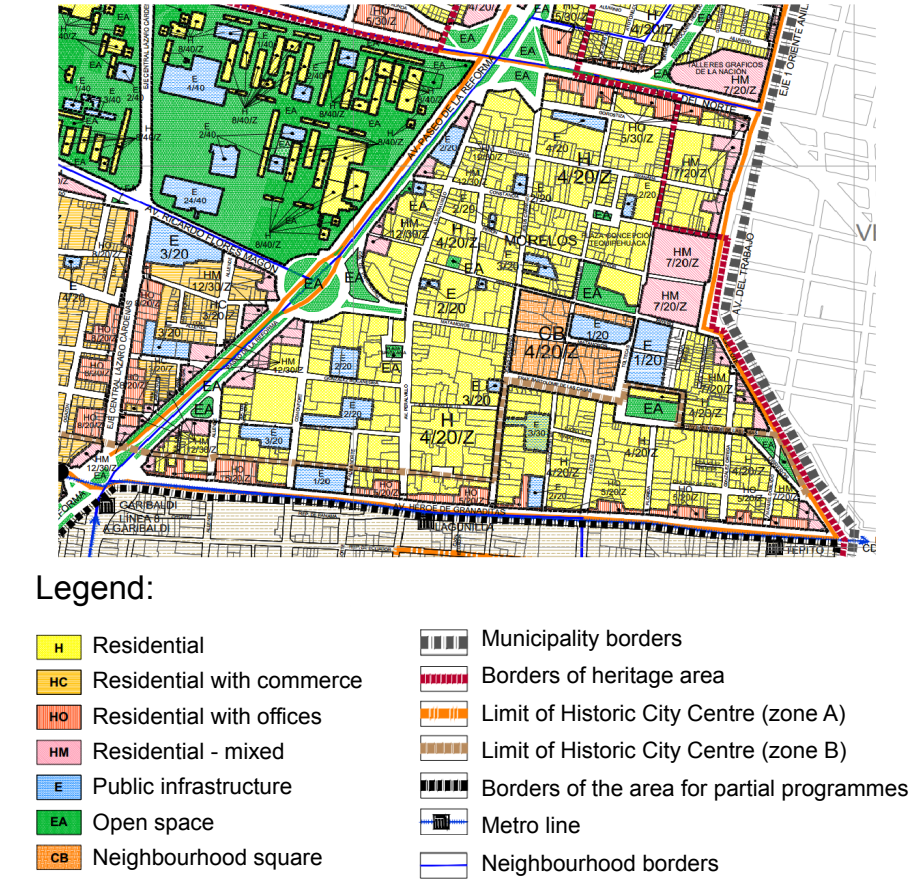
Figure 3.12: Tepito's markets, seen from within

Credits: Alfonso Hernández Hernández, Centro de Estudio Tepiteños

Figure 3.13: A residential street of Tepito

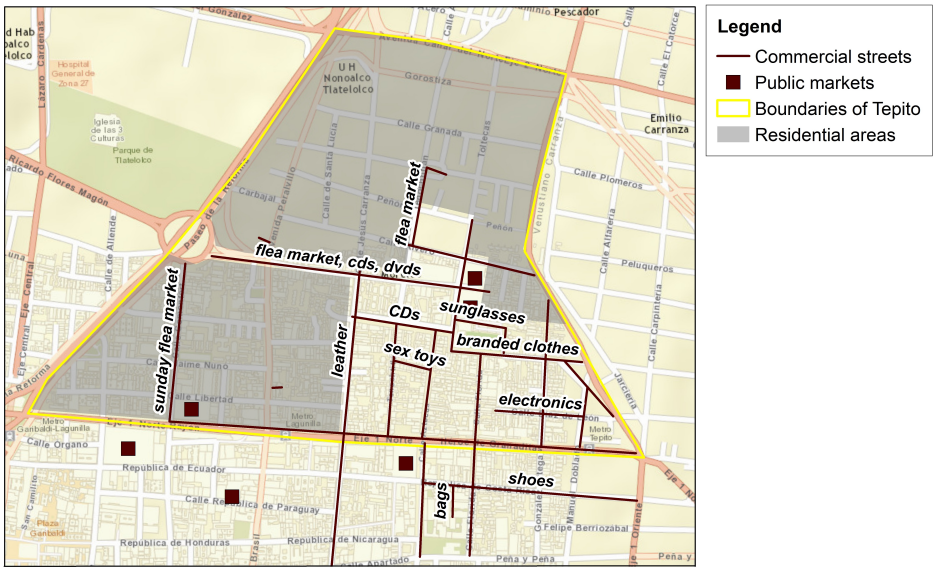
Source: Google street view, 2016

Figure 3.14: Local land use map as of 2016



Source: Website of the Cuauhtemoc municipality, 2016 - own translation

Figure 3.15: Observed land use and main markets



Source: Author's own elaboration, 2016

3.4.3 Governance network in Tepito

As a neighbourhood located in the Cuauhtemoc municipality, Tepito is governed by the Cuauhtemoc municipality, the Mexico City government, and to a lesser extent, the federal government. The municipality is in charge of providing basic urban services and maintaining the public infrastructure clean and in working order. Mexico City government's role is mainly one of policing, and ensuring the rule of law is maintained. Yet, this formal governance system is constantly challenged in Tepito.

Tepiteños and civil servants: a history of conflict. Tepito has always been a place that supplied the population with everything it could not access formally: jobs, housing, services, and basic consumer goods (as well as illegal goods such as arms or drugs). Because it could provide these services without the help of the government, it became a symbolically autonomous neighbourhood; and informality developed as an important part of the local culture. The pride of some of Mexico City residents around their informal status has been documented in a similar context to that of Tepito: in his book on street vendors in the historic city centre, Cross describes how informal employment is perceived to be much more than a mere subsistence activity:
"It was their own. They were not only "surviving" in the face of the crisis; they had the pride that their survival was due to their own efforts, and not just due to hand-outs from the government or dependence upon an employer". (Cross, 1998, p.1).

This observation applies to Tepito. Tepito residents' opinion of the government has been shaped by their informal status, which has resulted in a relationship between government and local actors characterised by antagonism and mistrust. Particularly, governmental actors' work is seen by local residents as detrimental to the life of the neighbourhood, which has always subsisted and thrived without the need for top-down planning. The government's various efforts to relocate street vendors into formal markets, or to improve the housing conditions through retrofit programmes, are seen by local residents as uninformed, top-down projects that only illustrate the government's incapacity to understand and plan for the urban poor's needs (Hernandez and Cross, 2006). One critique is based on the fact that the improvements proposed in various housing retrofit projects (in the aftermath of the 1982 earthquake) were imposed by the World Bank and were threatening social cohesion in the neighbourhood by favouring housing density and private spaces instead of the existing public spaces and patios. When this happened, local residents organised to propose their own alternative designs for their new housing units.

In parallel, the Mexican government's attitude towards the informal economy has been one of repression. Informal markets are seen as undesirable because they evade taxes and invade the public space, in addition to challenging the rule of law. In Mexico City, there have been

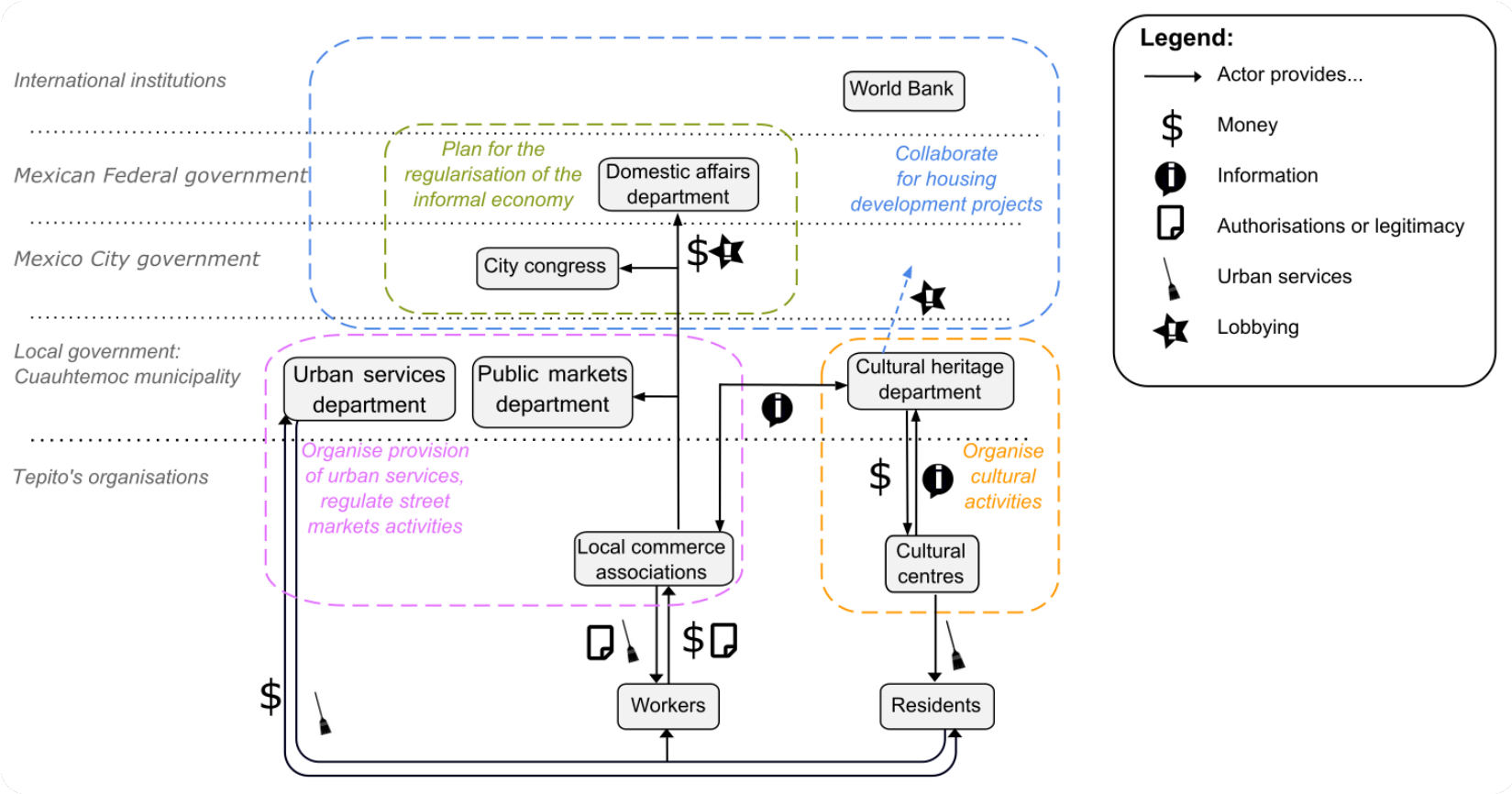
various waves of eviction of informal markets, which took place especially during urban regeneration programmes (Silva Londoño, 2010): the most recent effort to renovate and improve public spaces in the historic city centre (such as pedestrian streets, public places and parks) has been accompanied by a programme to forbid the (re-) installation of street vendors. This has strengthened the feeling among informal workers that the government unfairly favours the multinational corporations (through plans to build malls and chain stores) rather than the informal vendors, and fail to recognise their essential role in the urban economy. In other words, there is no formal recognition of the role that the informal economy plays in allowing Mexicans to earn a living, but also to provide everyday goods and basic necessities to low-income families who cannot afford to go to formal shops and malls.

Tepito's informal governance system. Tepito's governance system, discussed below, is represented conceptually in Figure 3.16, which shows the role of the main governmental and non governmental actors in local politics. The pink circle encompasses the different actors that are relevant for the informal provision of services - including waste collection and management.

Tepito's governance system is structured by the local commerce associations which represent the local street vendors. In Mexico City, most street vendors are grouped in associations that have varying levels of organisation and power. These associations act as a lobby that defend the workers' interests in front of the government. They intervene on an *ad hoc* basis, requesting meetings with governmental actors and invitations to present speeches in congress to comment on debated bills.

What makes Tepito's case special is the density and longevity of these organisations, which cover the whole southern area of Tepito, and are territorially based (rather than others which represent mobile street vendors). In Tepito there are no less than sixty-two of these organisations, each one with its own leader; and some are over forty years old. They are of various sizes (representing from twenty up to three thousand members), grouping the altogether twelve thousand workers of the street markets of Tepito. Each organisation represents one or various streets of the neighbourhood where a trade or crafts take place. The different leaders of the street associations, both from within and outside Tepito, associate freely to lobby as a group, depending on their political interests and opinions. However, it seems that some groups within Tepito traditionally oppose each other on political issues.

Figure 3.16: Key actors in Tepito's local governance



Source: Own elaboration, based on fieldwork (see Section 4.3 for more information on the fieldwork process).

The associations have various objectives: organising the street's land use (that is, managing the – informal – licences authorising each street stall); ensuring the provision of basic services (waste collection and security, among other), and finally, providing external representation of the workers in terms of legal support, negotiations with the police and local government, and lobbying in Mexico City's parliament.

Their level of organisation and formality differs greatly. For instance, some associations only manage the most basic task, which is that of managing the street stalls' licenses, collect taxes, and use these to negotiate with the police and the local government the right to work on the street. These associations may only be formed of the leader. Some other associations are more complex in terms of their organisational system, and provide multiple services in addition to managing licenses. The leaders might hire lawyers (to help with legal support), security officers (to act as a private police on the streets), waste collection workers and street sweepers, cleaners, cooks, doctors (to provide health consultations on a periodic basis), or architects (to plan for the improvement or renovation of the market structures). There are instances of the older, more organised associations, being formally registered as a non-profit association in the government's tax administration service, paying taxes and providing social security to their employees. This is an instance where informality (managing informal street markets) and formality (being a registered NGO) is blurred.

Tepito's street associations appear to be amongst the most influential and organised in the city, along with other city centre associations. The leaders not only organise the everyday life of the street, they are also the main point of contact with the government. They use many methods to interact with the government such as one-to-one meetings with government officials, participation and speeches in the congress, and informal negotiations. These negotiations entail power relations determined by, among others, the size of the electorate represented by street vendors, their role in the urban economy, as well as violence and threats. Because these negotiations happen behind closed doors and involve corruption and the exchange of resources for each representative's own benefit, the relationship between Tepito's informal workers and the local government can be characterised as one of clientelism (see Cross (1998)).

Interactions with government officials seem to be limited to three offices: At the federal level, interactions take place with the Ministry of Domestic Affairs (*Secretaría de Gobernación*), which is in charge of national security. At the state level, communication takes place mainly within the congress, where policies and laws regarding the regularisation of the informal economy are negotiated.

At the local level, most communication goes through the Public Markets Department, which grants the authorisation for street vending. On the other hand, another type of communication (probably less widespread) has been observed: there is a very close relationship between the Department for Cultural Heritage and local commerce associations. While the responsibilities of this department should be limited to promoting cultural events in the neighbourhood, in reality it plays a much more important role in Tepito's governance: it acts as a mediator between local residents and higher levels of governments. One example of this is in the case of the housing projects, where the office for cultural heritage helped organise the residents' proposal for new designs and presented them to higher levels of governments. This particular story might be anecdotal, yet it reveals how decision-making processes can be influenced by personal motivations and relationships, beyond the legal duties of civil servants.

3.5 Conclusion: Tepito's relevance for researching interactions between informality and waste management

This chapter started with describing the prevalence of informal processes in Mexico City's urban development. This contrasts with the narratives used in urban environmental management, which denies the role of informal workers in urban service provision: the second section of this chapter showed how informal waste handlers remain absent from government strategies and databases.

Studies of governance are moving away from the idea of linear, top-down policy making, and conceptualise governance as a process involving many actors and interactions at different scales. Thus, local politics does not only involve the design and implementation of legal documents, but rather the ongoing negotiations, collaboration and conflict between civil servants, stakeholders and citizens. As Silva Londoño (2010) and Cross (1998) have shown, workers within the informal economy are one such group of stakeholders who participate in urban management and governance.

In Tepito, informal workers are a particularly powerful group - this is due to the importance of the informal economy in the neighbourhood and the strong community ties that the workers have established among themselves. As a result, informal workers have played a crucial role in shaping daily practices, the use of space and the governance system.

In this chapter, I did not present Tepito's waste management system in detail. This is because there is no published research about the organisation of urban services in Tepito - or indeed in other neighbourhoods of Mexico City, with specific attention to informal processes. The contrast between the apparent prominence of informal activities in Tepito, and the lack

of understanding of how these govern the provision of urban services, and particularly waste management, reflects the paradox described earlier in the chapter: in Mexico City, it seems that informality plays a key role but very little is known as to how it interacts with urban environmental management. Tepito will make an excellent case study to explore this topic in depth.

Chapter 4

Methodology

This chapter presents the approach taken to studying waste management in an informal context. As Chapter 2 argues, studies of urban material flows have so far failed to integrate processes that take place in the informal city. This was exemplified in Chapter 3, which shows how considerations of informal waste handlers are absent from governmental datasets on Mexico City's waste management. The objective of this chapter is to address this challenge. It delineates the research approach taken in this thesis, based on primary data collection from a plurality of sources.

This chapter starts by stating the research objectives, then looks at epistemological considerations, presents the research methods, and ends with a reflection on the researcher's positionality.

4.1 Research objectives and research questions

4.1.1 Research objective

The overarching aim of the PhD is to contribute to answering the identified research gap: What is the role of the informal economy in urban sustainability? This derives from a methodological gap: How to study material flows in the context of the informal city?

The objective of this research is to explore the role of the informal economy in urban sustainability, through documenting the case of informal waste management in a neighbourhood of Mexico City.

4.1.2 Unit of analysis and scope

The theoretical framework has presented the concept of urban metabolism which is used to frame the research (see Chapter 2). Urban metabolism research focuses on material flows in order to explore the relation between the city and the environment. This requires looking at a material (in this case, waste) in a dynamic way, and looking particularly at its movements through the city, and the infrastructure and actors that allow it. In order to be recycled, a

piece of waste has to be transported from the place where it is first discarded (in the street outside a home or a shop, for instance), to the industrial zone where it will be physically and economically viable to recycle it. Looking at how waste is collected, processed and transformed into a recyclable material is the focus of the research. This analysis, although urban, goes beyond the city boundaries: most recyclable waste is recycled outside the city, thus it is essential to look beyond what happens in the city. Besides, it is necessary to go to the neighbourhood or even household scale to look at some aspects of waste flows. Thus, the focus is set on waste flows rather than a given geographical entity - in this sense, the study is multiscalar (McFarlane, 2013).

The literature review has shown that informal workers are particularly present at the waste collection and processing stage. In contrast, academic research on informal waste workers in Mexico City has primarily been researched at the disposal stage (that is to say, in landfills, see Castillo Berthier (1984)). Thus, this thesis focuses on the collection and processing stages of domestic (solid) waste management which takes place from the moment the waste is deposited in the streets by households and workers.

The unit of analysis is that of domestic waste flows produced in the neighbourhood of Tepito. The decision to focus on flows emerging from one single neighbourhood (rather than the whole city) is based on two reasons. Firstly, waste collection is organised at the neighbourhood level: the municipal teams of garbage-men operate at this level, and household practices of waste management (such as waste separation) differ among neighbourhoods. A municipal employee who managed different neighbourhoods within the same municipality (Mun8, interview 32) explains that socio-economic level and cultural aspects can explain the diversity in neighbourhood practices of separation. Secondly, it is a manageable unit for a four-year research project, where a coherent understanding can be gained of the whole neighbourhood.

The scope of the research excludes private sector collection. This is for two main reasons: firstly, I was not able to collect data from private sector collection.[1] The second reason is that through my observations and interviews with experts, the private sector does not appear to be a major actor in Tepito: according to Cit6, the proportion of waste handled this way throughout Mexico City is “minimal” (Cit6, July 2016).

[1] I asked for interviews to the relevant companies identified, all refused to participate. I also submitted an official request for information to the Ministry of the Environment, to access the database of companies which are registered with the Ministry as providers of a waste collection service in Mexico City - although this request was accepted in principle, after two years, the Ministry has still failed to provide this database.

4.1.3 Research questions

The overarching question that this PhD tries to answer is: What is the contribution of the informal economy to waste management - and its sustainability impacts - in the neighbourhood of Tepito?

There are three specific research questions:

1. How does waste flow through the neighbourhood of Tepito?
2. Which socio- political and physical factors organise these waste flows?
3. What are the consequence of these waste flows for urban sustainability?

The first question aims to identify those areas of waste management which rely on informal work, and to document the existence and role of informal workers. Documenting waste flows generally (not limited to informal work) allows to explore the unexpected informal work embedded within the formal system, and more generally to identify the interdependencies between formal and informal work. The second question aims to identify the governance system which shapes waste flows. In parallel, it also looks at the agency of formal and informal actors, and how their decision-making processes affect waste management. The last question aims to uncover the impacts of the current configuration of waste flows in terms of urban sustainability (as it is defined in the theoretical framework). Section 4.3.7 of this chapter (Table 4.5) shows how the different research questions are answered through the different stages of data collection and analysis.

4.2 The ontology and epistemology of urban waste flows

4.2.1 The city as object of study, and the value of a case study approach

The focus of inquiry of this research is the role of the informal economy in Mexico City's urban waste management system. This focus is a complex one: it involves many related but independent actors (the households and waste handlers), shaping directly or indirectly a socio-technical system (the waste management system), which is itself co-dependent on a range of physical infrastructures (such as the road networks) and social institutions (for instance, the municipalities).

Cities are complex systems, made up of multiple layers of social, economic, environmental, infrastructural and material processes which are all intertwined and coexist in a particular space. Their boundaries cannot easily be defined: with the rising importance of international flows in shaping our contemporary society, cities' geographical integrity has lost importance, as their footprints have become increasingly global and disconnected (Castells, 2010). As Amin

and Thrift note as an introduction to their book *Cities*, "cities have become extraordinarily intricate, and for this, difficult to generalize" (Amin and Thrift, 2002, p.1).

Any aspect of that complex system is co-determined by other aspects. To take an example: water consumption is co-determined by demography, industrial activities, the type of water provision infrastructure (and its state of maintenance) as well as the legal and policy frameworks that govern it. Therefore, research on water consumption requires an understanding of demographic, social, economic and governance urban dynamics (McFarlane, 2013). Thus, rather than focusing on universal causal relationships, urban research tends to explore particular urban processes in all their complexity and inherent interdependencies. This is not to say that no generalisation can be made in urban theory - but rather, this generalisation has to be made by looking at a multiplicity of urban cases, explored in-depth - for which the local context is primordial. The research presented in this thesis aims to provide one such case, by exploring the topic of informality in urban environmental management in the particular context of Mexico City, and providing the necessary background information on the city in order to make sense of the findings - this is the purpose of Chapter 3.

Different research approaches are adequate to answer different research questions. The "case study research" is particularly adequate when studying real-life context phenomena over which the researcher has little control (Yin, 2009). Case study research is also used in order to understand and explain a process in all its complexity (rather than, for instance, to generalise or prove causal relationships). The objective is to provide in-depth information on a single unit and identify general features of a phenomenon (Gerring, 2004). The case study approach appears well suited to address the research questions mentioned above, as it provides an opportunity to gain an in-depth understanding of the role of informal workers in the waste management system. In this sense it is exploratory research, looking to identify features rather than test or prove causality. It provides a rich understanding of waste flows, grounded in one particular context.

In order to choose a case, I refer to Stake's argument that a good case is that which offers "the most opportunity to learn" (Stake, 1994, p.243). This refers to finding a case which is interesting, from which our intuition tells us we can learn, as well as a place which is the right environment for learning (which is safe and hospitable). It is worth noting that typicality is not a characteristic of a good case study, as atypicality can provide a higher potential for learning (Stake, 1994). As Chapter 3 has shown, Tepito is a neighbourhood where informal activities are dense; this makes it an excellent case study because of its atypicality. Choosing an atypical (that is, non-representative) neighbourhood will evidently have consequences for the extent to

which findings from one neighbourhood can be transferred to other contexts. I do not claim that the findings of this thesis will only be relevant for Tepito or Mexico City - rather, the objective is that they can contribute to a larger body of empirical work from different regions of the world, which altogether enhances our understanding of how cities work. In parallel, because the context plays a huge role in a case study, the findings presented in this thesis always have to be contextualised by looking at the city's historical and contemporary dynamics (presented in Chapter 3).

4.2.2 The social construction of knowledge

Academic research exists within paradigms of ontology (what is possible to know about the world) and epistemology (how it is possible to know it) (Denzin and Lincoln, 1994). On the one hand, positivists believe that the purpose of research is to produce knowledge about the outside world in an objective manner. Although there are challenges to such an endeavour, positivist researchers nevertheless aspire to approximate as much as possible to an objective truth of the natural or social world. At the other end of the spectrum, social constructivists believe that our knowledge of the outside world is necessarily mediated by our cognitive capacities, technologies, personal experiences and ways of understanding the world (Guba and Lincoln, 1994). Knowledge is socially constructed, and the researcher plays an active role in shaping this knowledge. While positivist research tends to minimise the impact of the researcher (and its subjectivity) on the research process, social constructivists aim to explicitly acknowledge their subjectivity.

Research suggests that the way knowledge is produced influences policy outcomes. As Hajer puts it, environmental policy-making is based on (fragmented and imperfect) interpretations of nature (Hajer, 1995, p.17). By defining the topic, focus and approach of research, those who produce knowledge actually shape society's understanding of what a problem is, how it is framed, and therefore how to solve it. Even more, this process is many times invisible: as knowledge is presented as technical and objective, the biases and interests of people producing it are not critically assessed. Framing a particular research approach as an objective or technical process is thus a source of political power (Klinsky et al., 2016; Ehresman and Okereke, 2014).

Chapter 3 demonstrates that conflicting claims to knowledge coexist with regard to waste management in Mexico City. While an engineering approach to waste management (for instance, the governmental waste inventory) focuses on the top-down, governmental infrastructure put in place to manage urban waste and its environmental impacts (and therefore excludes independent actors such as informal waste handlers), an anthropological approach unveils the crucial role of informal actors in managing waste. This example shows how the research focus

and design (determined by the researcher) shape the outcome of the research. In that sense, I adhere to Geertz' description of data: "what we call our data are really our own constructions of other people's constructions of what they and their compatriots are up to" (Geertz, 1973). This will have implications in terms of my own positionality in this research, detailed in Section 4.4.

As Moore (2012) has argued, questioning the dominant conceptualisation of waste in a particular context is a way for social researchers to produce political research, "by undermining the modern shibboleths of cleanliness, order, sanitation, and hygiene integral to many exclusionary sociospatial arrangements" (Moore, 2012, p.792). Uncovering exclusion in waste management requires a critical engagement with the representation of waste in the knowledge production process. Considering the research question at hand, this is of crucial importance. The research looks at the informal economy, which includes groups of traditionally marginalised actors in both knowledge-production and policy-making processes. One of the motivations for the thesis is the lack of research on informal groups (in relation to urban environmental management) - yet this absence of information is arguably an *outcome* of the power embedded in the knowledge production process. Thus, the methodology needs to address this challenge by aiming to explicitly integrate informal actors' perspectives into knowledge production. In order to do so, it is necessary to aim to produce knowledge which allows for the inclusion of a multiplicity of perspectives on the topic of waste management.

Therefore, an essential aspect of the methodology is primary data collection with multiple stakeholders. The first step is to identify these stakeholders (informal and formal alike). This involves building an account of waste management from scratch, to address the previous exclusion of informal actors. In order to do this, I choose to use the method "follow the flow" to systematically track waste handlers along the waste management chain in a multi-scalar way (as these can have a local, urban or regional relevance). This method, borrowed from anthropology (Cook, 2004; Ingold, 2012) entails focusing on waste as the object of data collection (rather than waste handlers), and tracking waste flows as a means to identify waste handlers. Once these actors have been identified, it is possible to document their perspectives on the waste management system, as well as complementary data on those waste flows that had previously been excluded from waste management research.

4.2.3 Waste as a social object

Research on the sustainability of urban waste management systems tends to adopt a technical approach to waste management; this means that the physical transformations of the waste materials are the main focus of the research. Yet, waste management is a socio-technical system, which is composed of materials (the waste), infrastructure (for instance, the trucks) and people

(such as the waste handlers). While the social component of this system tends to be overlooked in waste management research (this critique has been made in Chapter 3, in the case of Mexico City's official waste management data), it is crucial to analyse it in order to understand how the waste management system works.

Indeed, as proponents of symbolic interactionism have shown (Charon, 2001), people's perceptions of the world determine their actions, which in turn shape our social world. People base their action on their understanding of reality - which is, as social constructivists argue, mediated by our capacities, experiences and way of understanding the world. Thus, rather than the reality itself, it is this *interpretation* of reality that determines how people act. Any enquiry about how society functions thus ought to document people's interpretations of the world.

Waste is a "social object" as defined by Charon, because its meaning is socially constructed, in a multitude of ways by different actors. As Mary Douglas has argued in a book exploring the concepts of dirt and purity, dirt can be defined as "a matter out of place" (Douglas, 1966, p.44), this means that an object is not intrinsically a piece of waste, nor dirt, but rather that it is constructed as such through cultural norms. In this sense, waste is defined collectively, depending on a socio-cultural context. Yet, as Drackner (2005) argues, the value attributed to waste is not only collectively defined, but also through individual subjectivities. Within a social group, some individuals may discard a piece of waste as useless, dangerous or bothering, while the same piece of waste is considered by others as a resource, and as such as "blessing from God" (Drackner, 2005, p.180). This differential of values attributed to the same piece of waste by different actors is crucial to understand waste-picking activities - this topic will be developed in Chapter 7. It is essential to understand which value different actors attribute to waste and how this value is attributed in order to address the second research question (which social factors shape the waste management system?).

A focus on people's interpretations of their practices, or their practices themselves? Symbolic interactionists argue that researchers interested in how the world works ought to focus on studying interpretations of the world (rather than the outside world itself) (Charon, 2001). Indeed, the approach taken in this research follows this idea: it aims to produce rich and diverse accounts of waste management, emerging from diverse stakeholders, to understand how their perceptions and agency shape the waste management system. The focus of the research is thus to produce what has been described by Geertz (1973) as a "thick description", that is to say, to set the focus not on actions, but rather on the meaning associated with these actions, which are composed of multiple layers of understanding of different actors. A thick description

entails showing different frames of interpretations (actors' worldviews) and how these, being co-present, produce a particular situation (Geertz, 1973).

Yet, waste handlers' practices and decisions around waste management can be better understood if there is adequate knowledge around waste flows, as the meaning that actors give to their actions can be contextualised by information on the actions themselves. This is why the research aims to document the materiality of waste flows along the interpretations of waste flows and their impacts. The combination of these two approaches aims to bring robustness to the research in two main ways. Firstly, contextualising actors' practices can help avoid misunderstandings and assumptions on the part of the researcher. Secondly, language is performative and what people say they do may be different to what they actually do, so it is necessary to contrast language with actions.

Mixed methods. In order to explore stakeholders' practices and perceptions, different methods need to be combined in a single research framework. Particularly, interpretations of the world are reached through conversations with actors (which can be formal, like interviews, or rather informal chats); while practices and outcomes are documented through observations (for civil servants, this can be a document analysis of a policy paper; for waste handlers, an observation of their daily work, or a survey). Indeed, qualitative and quantitative data may also be combined: interpretations will be qualitative, but observations of practices may be qualitative, quantitative and spatial in nature.

Triangulation plays a key role in enhancing the robustness of mixed-methods social research (Robson, 2002); although there are different reasons to use it, which produce different outcomes. Comparing and contrasting data obtained through different methods is traditionally thought of as a way to better approximate to an objective reality. This is only relevant in research designs which aim to document one such objective reality - which is not the case in this research. Rather, Coffey and Atkinson suggest that the data emerging from different methods help build alternative views of social reality; in this sense, triangulation is a way to gain a complex and plural understanding of the topic at hand (Coffey and Atkinson, 1996); it is this approach to triangulation that is used in this research. The next section of this chapter presents the methods of data collection and analysis used in this research, and how they are integrated in order to answer the research question.

4.3 Research methods

This section presents the data collection and analysis stages that make up the core of the research. For the sake of clarity, they are presented chronologically and in a linear manner.

However, it is important to note that the research took place in a flexible and iterative manner, characteristic of case studies (Robson, 2002). An iterative process means that the research question and methods might change during the research process. Particularly, a flexible design allows the research methods to be refined based on the experience of the data already collected. This has been crucial in this research, where each step of the data collection process was designed to inform the next. The research steps are summarised in Table 4.1, taking into account activities of data collection (fieldwork) and data analysis stages.

Table 4.1: Stages of data collection and analysis

Research steps	**Dates**	**Objective**	**Activities**
Identify institutional discourses on informality and sustainability	02/15	Gain an understanding of the local government's current policies and programmes affecting Tepito, and the informality narratives related to such policies	Semi-structured interviews with government officials and institutional actors and academic experts
Data analysis	03/15 to 06/15	Analyse institutional discourses	Discourse analysis
Ethnographic interviews with waste handlers	09/15 to 12/15	Gather in-depth knowledge on waste flows and their governance in Tepito	In-depth interviews with Tepito workers, observations, follow-the-flow
Preliminary data analysis	12/15	Identify key aspects of waste flows to include in the survey	Thematic analysis.
Survey	01/16 to 02/16	Gather quantitative data (and some qualitative data) on material flows	Surveys with waste collection workers and in recycling shops
Data analysis	03/16 to 10/16	Gain a qualitative understanding of waste flows and governance. Estimate quantities of recyclable waste flows in Tepito	Thematic analysis and quantitative analysis.
Writing-up	10/16 to 05/17	Produce a narrative for the thesis	Complementary analysis and writing up

Source: Own elaboration

The data collection took place over two stages of fieldwork in Mexico City. The first was a one-month visit to conduct interviews with experts and civil servants (at the federal, state and local levels of government). This stage of fieldwork took place in February 2014 and is described in Section 4.3.1. While this step was exploratory of the general research topic (urban metabolism, sustainability and the informal economy at the urban scale), this allowed the next step to be more in-depth, but also to ensure that the research questions and research design were coherent and adequate.

The second stage of fieldwork took place between September 2015 and February 2016 in Tepito. The objective was to document waste flows, to identify the actors involved - and how their worldviews and daily practices shape waste flows -, the governance system, and explore

issues of justice and sustainability. The type of data collected during this stage of fieldwork is varied (reflecting the complexity of the questions asked): some data is quantitative (how much waste is being produced and managed in a particular way), some is spatial (where is waste produced and managed) and other is qualitative (how waste workers' practices and worldviews shape waste flows). The data collection methods are ethnographic interviews and a survey; they are described in turn in Sections 4.3.2 and 4.3.3. These are followed by sections on organising the data, qualitative and quantitative analysis and writing up.

4.3.1 Interviews with experts and civil servants

The objective of this initial stage of fieldwork was to gain an understanding of the general context of the research, namely the government's current policies affecting the neighbourhood of Tepito, and the underlying informality narratives related to them. I carried out fifteen semi-structured interviews, over the course of one month in 2015, with civil servants, academic experts and representatives of international institutions. The interviewees were not all experts in waste management but rather in urban sustainability and environmental management more generally. This allowed me to gain a more general understanding of urban environmental planning in Mexico City, and the role of informality within it - as perceived by the interviewees. I used discourse analysis to build an understanding of how civil servants' discourses on the informal economy are co-determined by their visions for urban environmental planning.

Selection of participants. In order to identify key actors (and thus potential interviewees), I made a map of actors that are expert in different themes, such as energy, water, environmental policy, urban planning, waste management, food supply, employment and infrastructure planning. For each of these themes, key actors were identified in the following professions: civil servants (at the municipal, state and federal levels), academic experts, representatives of international institutions (for instance, UN Habitat or UNEP), and relevant NGOs. All had a working knowledge of Mexico City or Tepito. They were contacted by email to ask for an interview. This list of actors was complemented during the fieldwork, as some key actors were only identified by recommendations from interviewees and through informal discussions. They were contacted in the same way, by email. In total, thirty potential participants were contacted and fifteen interviews were carried out.[2]

The interviews are listed in Table 4.2. The column "Data ID number" refers to a unique number given to each interaction with a research participant. The column "Reference in text"

[2]Half of the individuals I contacted did not reply to my email or refused to take part in the interview. Thus, one of the biases of this work is that it only takes into account the opinion of people who were willing to take part in the interview (in particular, I was unable to interview actors from utilities companies, social development and infrastructure planning).

defines how interviews are quoted throughout the thesis, according to the type of actor: municipal civil servants (Mun), Mexico City civil servants (Cit), federal civil servants (Fed), academic experts (Exp), and third sector (Inst).

Table 4.2: List of interviewees - institutional discourses

Data ID number	Profession	Interview date	Duration	Reference in text
1	Civil servant	February 10th	1 hour	Cit1, Cit2
2	Civil servant	February 12th	50 min	Cit3
3	Civil servant	February 13th	1h20min	Cit4
4	Academic	February 16th	1hour	Exp1
5	Civil servant	February 17th	55 min	Mun1
6	Civil servant	February 20th	55 min	Mun2
7	Third sector	February 20th	45 min	Inst1
8	Third sector	February 22nd	1h10min	Exp2
9	Academic	February 22th	55 min	Exp3
10	Civil servant	February 25th	1 hour	Fed1, Fed2, Fed3
11	Academic	February 25th	55min	Exp4
12	Third sector	February 27th	1h10min	Inst2
13	Civil servant	March 2nd	30 min	Mun3
14	Civil servant	March 2nd	1 hour	Fed4
15	Civil servant	March 3rd	2 hours site visit	Mun4, Mun5

Source: Own elaboration

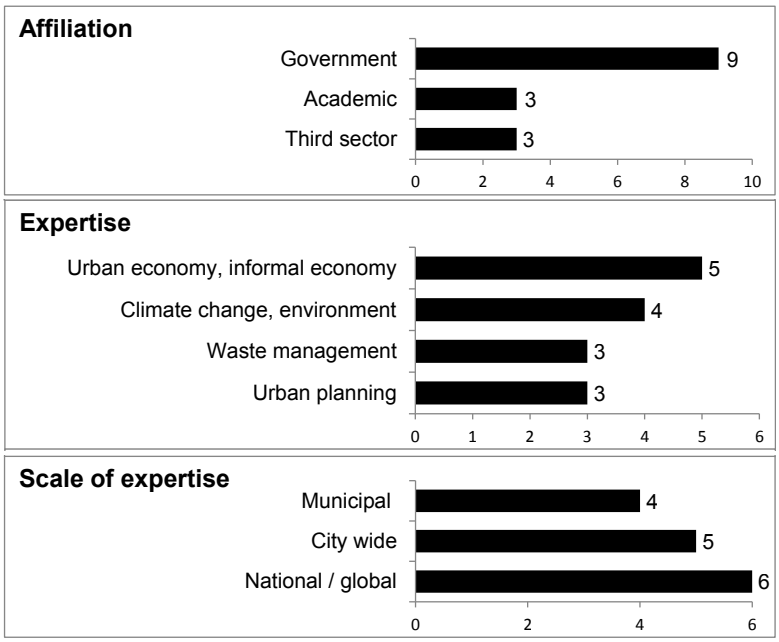
In order to preserve anonymity, I do not include more information characterising interviewees specifically. Instead, I provide, in Figure 4.1, general information as to the interviewees' affiliation, expertise and scale of expertise. Experts in climate change, the environment, informality, waste management, urban planning and the informal economy were interviewed.

The interview process. The interviews were based on an interview guide, which is reproduced (translated into English) in Annex B. The main topics discussed in the interview were the informal economy, policies addressing it in an urban context, and the potential role it can play in urban sustainability. The interview guide allowed for digressions and for the interviewees to expand on the topics they deemed relevant. Interventions from the interviewer were kept to a minimum (guidance) in order to gain a better understanding of the interviewees' own ideas and values. Probes were used to encourage interviewees to expand on their thoughts when necessary.

The participants were given an information sheet and informed that the data would be anonymised, and that their names would not appear in the research (for information on consent, see section 4.4); the information sheet is reproduced in Annex C. The interviews were recorded and subsequently transcribed.[3]

[3]Two interviews were not recorded. In the first case, this was because the interviewee did not provide consent; and in the second case, because the interview took place as a site visit. In both cases, notes were taken during and

Figure 4.1: Characterisation of experts and civil servants interviewees as per their affiliation, expertise and scale of expertise



Source: Own elaboration

One interview (with Mun4, a civil servant working with waste collection) took place as a site visit, which was a car drive through the neighbourhood in order to meet the municipal waste collection team and see their work. Although I did use the questions set in the interview guide, the interview took place as an unstructured discussion. This was not problematic though; on the contrary, the discussion benefited greatly from the mobility a site visit provides: I asked questions as I witnessed events in public spaces, while observing the work of the waste collection team, and could prompt the interviewee to describe specific sights he chose to point me toward. The success and richness of this interview served as a base to design the mobile interview process (the "go-along interview") of the following stage of fieldwork.

This stage of fieldwork provided contextual information about informal waste management in Mexico City (particularly, who the main actors are and what the governance system is like). This helped me design the next stage of fieldwork, by identifying the waste workers to be interviewed and the topics of interest to include in the interview guide.

4.3.2 Ethnographic interviews with waste handlers

During the second stage of fieldwork, I went daily to Tepito for over four months. It is difficult to disentangle the methods of data collection used in that time: I alternatively observed, had informal chats with waste workers, and conducted formal (although unstructured) interviews.

after the interview in order to provide a written recollection of what was said by the interviewee, as close to the reality as possible.

Most of the interviews happened on the spot: I would meet someone and ask if I could have a chat with them, and that would become a two hours long interview. I got used to these different activities overlapping, and had a pen and paper, a digital recorder and information sheets with me at all times. This process of data collection is a type of "ethnographic interview", described by O'Reilly as follows:

"For ethnographers, interviewing and listening go on all the time. There may not be a clear distinction between doing participant observation and conducting an interview. [...] Discussions go on all the time and in a variety of contexts. However, it could also be that the ethnographer finds it useful or necessary to take people aside and try to talk to them in a more predetermined way [...] when there may be fewer interruptions from other people and from unfolding events. [...] it may be that the main data gathering technique is interviewing, in which case ethnographic fieldwork provides a context for building relationships with people that can improve and inform qualitative interviews". (O'Reilly, 2005, p.115)

Ortiz (2003) provides some further characteristics of ethnographic interviewing. First, it takes place *in situ*, which means that the topic being discussed can be more easily related to the socio-spatial context it is embedded in. Secondly, it tends to take place over more extended periods of time, which provides an opportunity to create a fruitful *rapport* and a climate of trust.

Although traditional ethnography tends to be the preferred data collection method to look at practices (one key topic of this research), some research shows evidence that "people can talk about their practices" (Hitchings, 2012); therefore practices can be documented both through observation and interviews. Indeed, many interesting insights on practices were collected through the interview method, and particularly as a follow-up to an observation. The interview, taking place in a (relatively) quiet environment, allowed me to ask the participants to explain to me aspects of a practice I had previously observed. This had two benefits:

- Interview and observation data could be triangulated: practices I might have misinterpreted through observation could be clarified, contextualised and explored more in-depth in the interviews.

- During the interview, practices could be explored as embedded within deeper issues of power and justice. One example is the topic of corruption - although corruption could be observed; asking about corruption in an interview allowed for a much deeper understanding of its meaning for the participant, its causes and effects and the impact on waste flows.

Observations and informal chats. Observations were a more or less prominent feature of every interview. For instance, in order to interview a street leader (a very busy and important local character, in charge of a local commerce association), I had to go to his office various times and talk to his staff to arrange the interview; it was rescheduled twice, and each time I was left waiting in his office area. During this waiting time, I both observed and had informal chats with different people who happened to be in the office; interactions which provided valuable information about the organisation of local commerce associations. This scenario repeated itself in different contexts: the interview with employees of the Municipal Transfer Centre included a site visit and meeting other employees; and during an interview with a civil servant, three employees were invited to join and provide alternative inputs to my interview questions.

In addition to these events, I did a participant observation in one particular recycling shop, where I went daily for a month. There as in the previous case, I combined informal chats and observations. This allowed me to observe situations which I did not fully understand, and to ask questions about them, providing valuable insights. I repeated this exercise every day until I felt, after a month, that I had reached saturation (Small, 2009): by that time I was merely going to the centre out of habit, but was not learning anything new anymore. This is when I stopped and moved on to other activities. During this month, I chatted with all the employees of this centre, helped for two half days, took pictures, asked questions, joined the owner on his trips to sell recyclables, met the clients; and arranged thirteen interviews with people I had met there, or through the owner's introduction. I also took extensive fieldwork notes that are a key source of data for the research.

Within this activity of observation, I had informal chats with many people, which are conversations for which participants were not asked to participate in an interview (although they were always aware I was a researcher). This type of chat is not ideal and was never planned; it refers to discussions that took place on the spot - on any waste-related topic-, sometimes with more than one person, when I was not able to ask to have a formal interview. However, these discussions were so valuable that they are used as a data source. In one case (see Data ID 17 in Table 4.3), the informal chat took place as a first meeting, which was followed up by a formal interview (24). In another case (22), the formal interview was not fruitful, as it took place in a crowded office belonging to the interviewee's boss - the interviewee was visibly uncomfortable at the idea of discussing sensitive issues. In this case, the informal chat took place as a follow up (22b) to provide a more intimate discussion setting. Interview 19 was informal as it took place with a street leader, who categorically refused a formal interview, yet was very keen on having

long discussions and allowed me to take notes. The last informal interview (23b) also took place as a follow-up, to refine and clarify concepts mentioned in a previous formal interview.

The go-along interview. Some interviews were mobile. I accompanied waste workers when they were transporting waste - usually in pick up trucks. This would allow me to "follow the flow" and to map the different sites where waste is handled before disposal. It also allowed me to identify new waste handlers further along the waste management chain, which was a key input for answering the first research question.

According to Kusenbach (2003), the go-along interview builds on the strengths of the ethnographic observations and the formal interview: it allows discussion with the participant, as well as benefiting from the *in situ* conditions: this type of method is particularly relevant to analyse "spatial practices", that is to say, how participants relate to their environment. For instance, this method allowed me to discuss with interviewees the routes they use to collect and transport waste, and how these routes are determined by physical factors (the presence of avenues that are difficult to cross for waste-pickers, or traffic for recyclable traders), but also social ones (driving outside of policed areas to avoid contact and the request of a bribe). I was able to discuss these topics only because I observed particular practices while on a go-along interview.

Selection of participants. I invited to participate in the research, any waste handler or other actor who could provide me with information as to how domestic waste is managed in Tepito. I started with informal and formal waste workers that I knew of, and through the process of the interviews, I kept updating my list of potential interviewees, as I was discovering new waste workers or other key actors. By "following the flow", that is to say, documenting waste flows in a systematic way, I was also able to discover the role of different actors in the waste management process, and therefore to identify potential interviewees.

Interviewees include waste-pickers, workers in recycling shops and in the recycling industry (the independent waste handlers). It also includes an informal street sweeper and his employer (a street leader). Garbage-men and truck drivers make up the municipal waste collection team. I also interviewed two metal sculptors because they both use recycled metals in their work, and thus provided me with an alternative perspective on the re-insertion of scrap metals in a productive process. Finally, I interviewed some municipal employees in charge of waste collection services, city employees in charge of the Municipal Transfer Centre, and one government consultant.

As I tried to move along the chain of actors handling recyclables, I identified the recycling industry (wholesalers of recyclable materials and recycling factories) as the endpoint for many

recyclables. I thus contacted them to arrange interviews and site visits. However, nobody accepted to provide any information at all - the reason they stated was that I might get in on "industry secrets". The only interview I could do in this sector was with a small-scale wholesaler in the metropolitan area of Mexico City, who himself sells to bigger wholesalers. Likewise, finding information on private companies collecting waste in Tepito proved difficult: the only information I was able to gather was through an email interview, with a follow up. This is one of the limitations of the findings of this research.

Structure and topics of the interviews. Some interviews took place at the person's workplace, and over long periods of time - this includes the go-along interview. These interviews might be recorded, although most were not, and were completely unstructured: I would merely observe the interviewee in his daily tasks and ask them to explain what they were doing and why.

In other cases, the interviewee would be sitting down, not conducting any other task, and would usually be recorded. The discussion would be unstructured (with no precise interview guide) and would generally allow for more in-depth exploration of particular topics (relationships with other waste handlers, corruption, health, informality and risk, etc.).

In both cases, the topics touched upon in the interviews were very loosely defined. The main topic was that of waste flows, and I would start by asking the interviewee to describe his relation to waste in Tepito. For a waste worker, this would mean describing his daily work to me in detail. This part of the interview was unstructured.

In addition, I would ask questions about key topics that were necessary to answer the research questions. These topics were identified in the first round of interviews with government officials and experts, and are the following:

- health hazards
- environmental impacts
- causes and consequences of informality
- cooperation and conflict with other waste workers
- cooperation and conflict with the government (or, for governmental interviewees, cooperation and conflict with informal workers)

List of interviews. The list of interviewees is presented in Table 4.3. The column "ref in text" refers to how the interviewees are quoted throughout the thesis: interviewees are labelled as either Mun (municipal civil servants), Cit (Mexico City civil servants), Art (Metal sculptors), Org (street associations), and Wh (waste handlers).

The column "Interview type" identifies which of the interviews are informal chats. The column "Rec?" differentiates which interviews were recorded and which were not (in which case I took written notes during and after the interview). I tried to record all interviews, however, sometimes interviewees would not provide their consent; informal chats were not recorded, and some of the formal interviews were not recorded for practical purposes (as they were spread out during whole work days). In addition, interviews 17, 19, 20, 20b, 22b, 24, 31, 32, 39, 50a and 50b were group interviews.

Table 4.3: List of interviews with waste handlers

Data ID number*	Interview type	Rec?	Profession/place of work	Interview date	Duration	Ref in text
16	Formal	No	metal sculptor	24/09/15	one day	Art1
17	Informal	No	Mun Transfer Centre	06/10/15	2 hours	Org1, Mun6, Mun7
18	Formal	Yes	metal sculptor	06/10/15	30 min	Art2
19	informal	No	street leader	07/10/15	1 hour	Org2
20	Formal	Yes	recycling shop	09/10/15	1h25	Wh1, Wh2
21	Formal	No	recycling shop	10/10/15	30 min	Wh3
22	Formal	Yes	street sweeper	10/10/15	5 min	Wh4
22b	informal	No	street sweepers	10/10/15	15 min	Wh4, Wh5
20b	Formal	Yes	recycling shop	13/10/15	1 hour	Wh1, Wh2
23	Formal	Yes	recycling consultant	13-14/10	2 hours	Wh6
24	Formal	Yes	Mun Transfer centre	15/10/15	1h30	Mun7, Org1
25	Formal	Yes	recycling company	20/10/15	17 min	Wh7
26	Formal	Yes	waste-picker	27/10/15	20 min	Wh8
27	Formal	Yes	waste-picker	27/10/15	30 min	Wh9
28	Formal	Yes	waste-picker	27/10/15	25 min	Wh10
29	Formal	Yes	waste-picker	27/10/15	2 hours	Wh11
30	Formal	Yes	waste-picker	29/10/15	15 min	Wh12
31	Formal	Yes	mun collection team	30/10/15	1h20	Wh13, Wh14, Wh15, Org1
32	Formal	Yes	mun collection team	30/10/15	1h 35	Wh16, Mun6, Mun8
33	Formal	No	gvnt consultant	04/11/15	45min	Cit5
38	Formal	Yes	waste-picker	10/11/15	11min	Wh17
39	Formal	No	waste-picker	10/11/15	30 min	Wh18, Wh19
40	Formal	Yes	recycling shop	11/11/15	40 min	Wh20
50a	formal	No	municipal collection	16/01/16	1 hour	Wh21, Wh22
50b	Formal	No	municipal collection	19/01/16	30 min	Wh21, Wh23, Wh24, Wh25, Wh26
33b	Formal	No	gvnt consultant	22/02/16	1hour	Cit5
55	Formal	Yes	civil servant	12/02/16	1hour	Mun9
56	Formal	Yes	civil servant	12/02/16	1hour	Mun10
23b	Informal	No	recycling consultant	03/03/16	1hour	Wh6
57	email	-	private collection	19/05/16	-	Wh27
58	email	-	civil servant	06/09/16	-	Cit6

* The Data ID number starts at 16, following the 15 interviews presented in the previous section (Table 4.2). IDs labelled with a *b* (for instance, 22b), refer to a second interview with the same interviewee.

Source: Own elaboration

4.3.3 The survey

Introduction: objectives of the survey. The objective of the survey was twofold: first, it was to quantify formal and informal waste flows through the neighbourhood. This is a necessary step as the share of the informal economy in total waste management is unknown in Mexico City.

The second objective of the survey was to contextualise the findings of other methods of data collection. Conducting a survey with a wide number of participants is a way to assess the representativeness of the data gathered through the ethnographic interviews. I thus used the survey as an opportunity to collect qualitative information also, particularly when participants were mentioning concepts or issues that had not been mentioned in the previous phases of data collection.

Research design: finding the bottleneck. In order to quantify waste flows, it is necessary to first choose a starting point, that is, one point in the waste diagram where the waste is to be quantified. This is necessary to avoid double counting (for instance, quantifying the same waste twice, when it is collected, and when it is bought by another actor); but also to make the quantification feasible (for instance, it is not realistic to go out one night and weigh all the recyclable waste deposited in the street).

I used both the waste diagram and the recycling chain produced through the analysis of the data collected in the ethnographic interviews (presented in section 6.3.4) in order to identify one particular point where recyclable waste flows being produced in Tepito can be quantified. By looking at the recycling chain, I identified the small recycling shops acting as a bottleneck, channelling recyclable waste outside of Tepito. The next actors in the chain are bigger recycling shops, which are scattered in the metropolitan area, and who collect waste from all over the region. It is impractical to quantify waste flows through these bigger recycling shop, as they gather waste from the wider region. On the contrary, the small recycling shops only gather waste that has been collected in Tepito: interviews with informal waste pickers - the small recycling shop's main providers - and other providers, confirmed that apart from a few exceptions, they all gather the recyclable materials within Tepito's boundaries. This is because there are many recycling shops scattered in every neighbourhood, so there is no need to walk far to find somewhere to sell one's waste. In addition, the neighbourhood is surrounded by avenues with heavy transit, which are difficult to cross as a pedestrian; these act as physical boundaries, which waste-pickers tend not to cross (see Figure 4.2).

The waste can be quantified through the small recycling shops which act as a bottleneck in the recyclables chain. This makes the data collection manageable, as these are scattered within

Figure 4.2: One of the avenues surrounding Tepito

One can observe that although a zebra crossing is painted on the floor, there is no light to indicate pedestrian crossing.
Source: Author's own, 2015

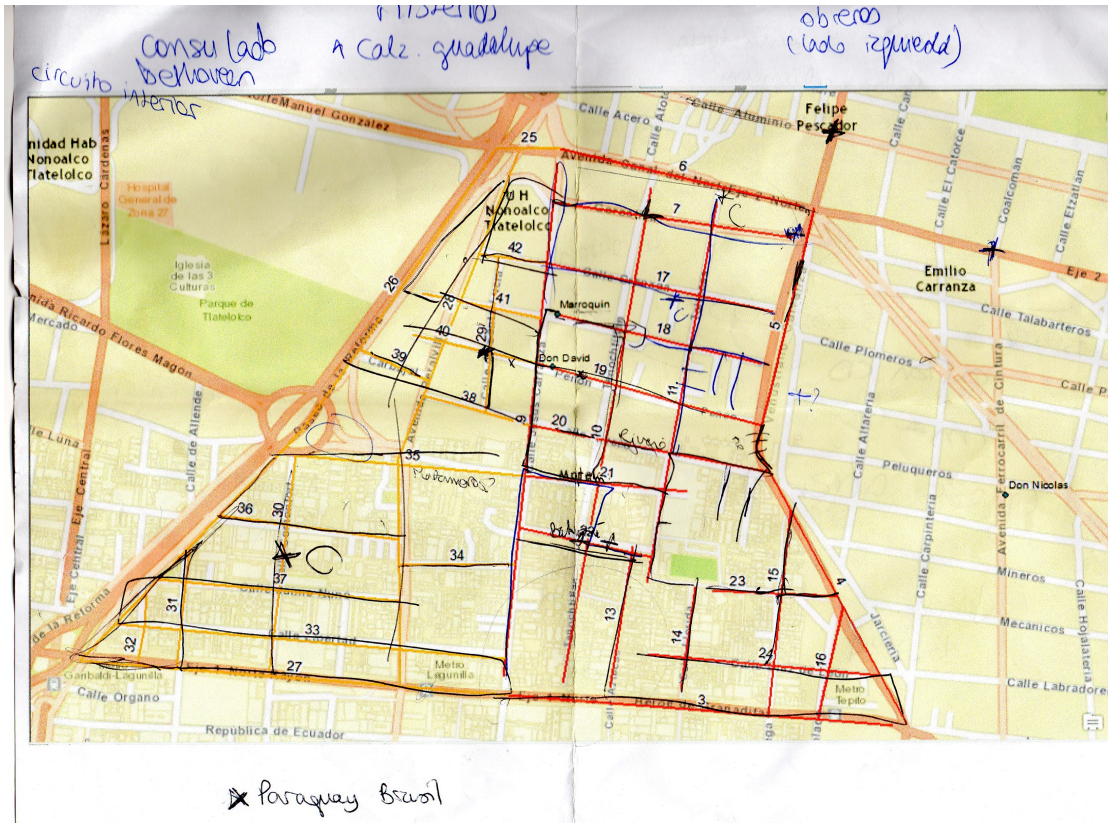
a 1km^2 area (the boundaries of Tepito). I thus decided that the data collection method would be a survey in the small recycling shops. Although the small recycling shops are the main actors transporting recyclable waste outside Tepito, they are not the only ones. By conducting interviews with municipal employees, I found out that many of them separate some recyclable waste and sell it outside the neighbourhood. This is only true of truck drivers (the street sweepers also separate waste, but always sell the recyclables in the small recycling shops, who are close by). I therefore conducted the survey only with truck drivers, to avoid double counting the waste collected by street sweepers and sold to Tepito's small recycling shops.

The other two actors I could identify that take recyclable waste outside Tepito are the private company who collects waste from a few public buildings - probably health centres and schools -; and some trucks who come to buy waste directly from informal waste pickers (some come at night, some are parked in specific places). It was not possible to get more data on either of these two actors, however, according to interviews with experts and local waste handlers, they represent a small fraction of waste management in the context of Tepito. The method chosen

was thus two sets of surveys, one with small recycling shops, and one with municipal waste collection truck drivers.

Survey in recycling shops. As already explained, from my interviews with informal waste-pickers, I gathered that they go to sell recyclable waste to small recycling shops scattered around Tepito. I estimated that there might be around ten of them. Being informal, these do not appear in the census or any other formal registry. I thus decided to walk all streets of the neighbourhood in order to identify these recycling shops. I used a map, crossing off each street I had walked, and making a note of each recycling shop I passed by (see Figure 4.3).

Figure 4.3: Copy of the map used during the walking exercise

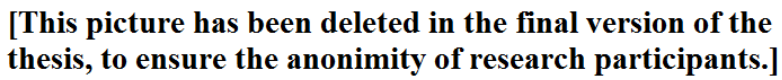


Source: Author's fieldwork

Most waste-pickers had explained me that they do not cross the boundaries of Tepito in order to sell their material (due to the avenues bordering the neighbourhood) which is why I did not walk further than these boundaries. While walking around the neighbourhood, whenever passing by someone who was gathering recyclable waste (in the street or in shops), I would ask where they would go and sell it, and use this to identify further recycling shops. After walking around all streets and asking questions, I identified twelve recycling shops, including the one where I did a participant observation. Three of them were located outside the borders of Tepito,

however I did include them in the survey as many waste-pickers confirmed that they sold their materials there. The recycling shops are presented in Figure 4.4.

Figure 4.4: Small recycling shops in Tepito



Source: Own elaboration

I surveyed eleven of the twelve centres identified on the map (one refused to participate). In addition, in one recycling shop, the employee agreed to participate but could not answer most questions; he was new and did not know much about the business. In these two cases, I observed the size of the warehouse and the number of employees, and I estimated the materials being traded, by comparison with the data from the other recycling shops (these are the two cases with the mention "observation" in Table 4.4).

The surveys took between ten and thirty-five minutes to complete. The questions list was informed by the previously conducted ethnographic work in the recycling shop, which was crucial in framing both the content and the format of the questions. The main topics were: how big and how old is the recycling shop, who comes to sell waste and how, how is the waste processed, where is it sold and how, how knowledge and skills were acquired, and relationships with government. The survey questionnaire directed at workers in small recycling shops can be found in Annex D.

Survey with collection truck drivers. In Tepito there are two municipal waste collection sectors: Gorostiza and Lagunilla (see Figure 6.5). In Gorostiza, there are about forty employees,

of which eight are truck drivers. The others are street sweepers and helpers on the trucks. In Lagunilla, there are only three trucks, and thus three drivers. I aimed to interview all of them, but was only able to interview seven in Gorostiza, and 1 in Lagunilla (the other two were not around on the days I conducted the fieldwork). Similarly to the case of the recycling shops, I estimated the quantities of recyclables being separated, based on the size and route of the truck with the missing data.

The survey had to be quick, as these workers are always in a rush and have a lot of work. Thus, I had to make a survey that could be completed in five to ten minutes. I decided to focus on the waste separation process, what type and how much of recyclable waste was separated and sold, and how was the money earned this way to be used. These three topics emerged from the previous stage, where I could conduct two in-depth interviews with truck drivers (for instance, I became aware that some of the money earned by the sale of recyclables was used to maintain and repair the trucks - this became a question in the survey). The survey questionnaire directed at waste collection truck drivers can be found in Annex E.

In order to gain access, I first went to the managers of these two sectors and explained my research to them. I interviewed both of them formally, and then asked permission to conduct the survey, which was granted in both cases.

List of survey participants. The list of survey participants is presented in Table 4.4.

Table 4.4: List of survey participants

Data ID number	Profession	Survey date	Note
34	truck driver, Gorostiza	09/11/15	
35	truck driver, Gorostiza	09/11/15	
36	truck driver, Gorostiza	10/11/15	
37	truck driver, Gorostiza	10/11/15	
41	truck driver, Gorostiza	11/11/15	
42	truck driver, Gorostiza	12/11/15	
43	truck driver, Gorostiza	12/11/15	
51	truck driver, Lagunilla	16/01/16	
21b	recycling shop	10/10/15	
20c	recycling shop	30/10/15	
40b	recycling shop	11/11/15	
44	recycling shop	11/01/16	
45	recycling shop	11/01/16	
46	recycling shop	12/01/16	
47	recycling shop	12/01/16	OBSERVATION
48	recycling shop	12/01/16	OBSERVATION
49	recycling shop	14/01/16	
52	recycling shop	19/01/16	
53	recycling shop	19/01/16	
54	recycling shop	20/01/16	

Source: Own elaboration

4.3.4 Coming back from the field: organising the data

After the fieldwork, the data was digitalised and organised. The data was first classified in four categories:

- Transcripts of recorded interactions with participants (surveys or interviews), identified with a Data ID number;
- Fieldwork notes from observations;
- Geographical data, stored in a Geographic Information System;
- Pictures.

It was then organised in separate folders according to their category, and an Excel table was made which summarises basic information about each dataset (see Tables 4.2, 4.3, 4.4). The documents were anonymised, and participants' names were replaced by unique references (for instance, "Mun1"). Then, I looked over the data and carried out a primary coding where each bit of data was assigned to (a) particular research question(s) that it would help answer.

The software *Nvivo* was used to organise the data and perform an initial coding. Most codes were inductive and emerged from the data. Others were determined by the research questions, such as the topic of sustainability impacts of informal work. At this stage, a lot of data was discarded because it did not help answer the research questions: as the interviews were unstructured, sometimes the interviewees would talk about their personal life or other topics irrelevant to the question at hand. In this case, the coding (or lack thereof) allows me to identify which data to use to answer my research questions. As a result, the analytical chapters do not exhaustively describe the data, but rather that which is relevant to the research questions.

Translation. The transcripts were not translated from Spanish to English, in order to avoid loss of context and meaning (for a discussion, see Smith, 2003, pp.184-185). Yet the analysis was done in English, and direct quotes were translated to be inserted in the final text.

4.3.5 Qualitative analysis

I conducted two separate analyses of the qualitative data. On the one hand, the interviews with experts and civil servants were used to perform a discourse analysis. On the other hand, the ethnographic data from Tepito (interview data, fieldwork notes and photos) were used to conduct a thematic analysis. In both cases, the objective of the analysis was to produce a pluralistic narrative around the role of informal workers in Mexico City's urban waste management.

The main activity conducted as part of the qualitative analysis was to systematically read interview transcripts (and other data sources) in order to uncover some themes that are relevant

to answer the research questions. Some of the themes identified were done so deductively (for instance, the topics of informality and sustainability had previously been identified as key aspects of the research), while other themes emerged inductively from reading through the data (this was the case with the topic of racism). Thus, the research process was iterative, as the identification of new themes altered the research process: for instance, some themes that were identified in the first set of interviews were included in the interview guide of later interviews. The identification of new themes also required further reading to be conducted in order to contextualise the theme - this was the case for the themes of solidarity networks and racism, which emerged from the interview data. Once key themes were identified, I constructed the story of Tepito's waste metabolism through organising the empirical chapters of the thesis in a particular way; my objective was to represent the complexity and diversity of perspectives on waste management emerging from different actors, while providing a clear narrative for the reader.

4.3.6 Quantitative analysis

Data from the surveys and selected interviews (that had quantitative elements in them) were harmonised and analysed to produce an estimation of the recyclable waste produced in the neighbourhood of Tepito. The data is thus based on surveying most of the waste handlers who transport waste away from the neighbourhood. However, there are three points to bear in mind when assessing the confidence of the data: firstly, the quantities of waste being traded change constantly, according to cultural events (Christmas time means more waste being produced, for instance), weather (it is harder to pick waste under heavy rain), and international markets (when the dollar exchange rate falls, then the materials are bought more cheaply and thus are not picked by waste-pickers). The survey was produced in a relatively representative month (November, no particular cultural event; no rain). However these quantities are bound to evolve.

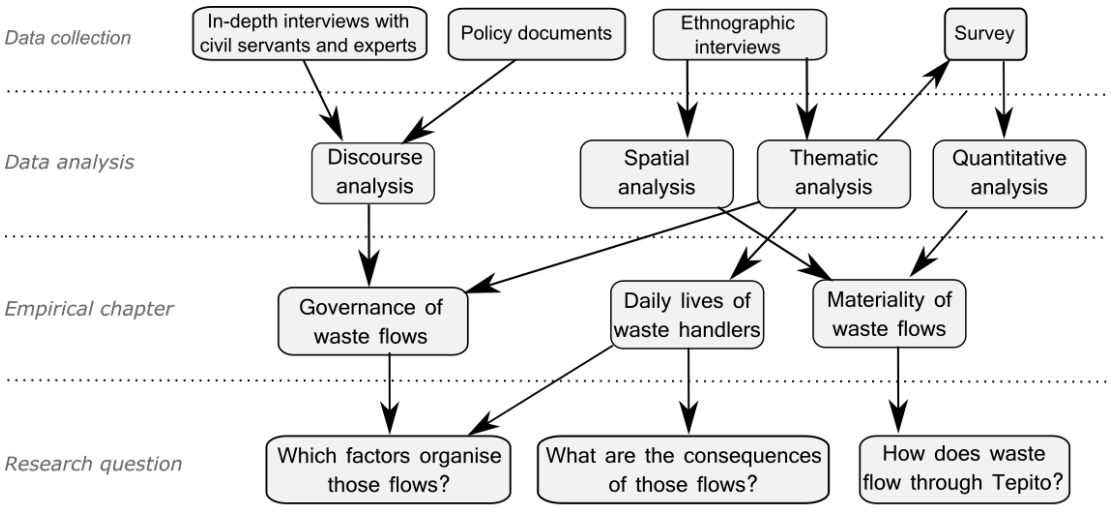
Secondly, the quantities were asked in a very short survey. Most interviewees estimated the materials they trade, starting with the materials they trade most. Usually, they would not estimate smaller quantities (for instance, if a worker trades metal, but it is not their main trading material, they would merely say "a bit of metal", rather than a specific quantity). In these cases, I did not attempt to quantify these material flows but rather focused on the quantified flows of the main materials being traded.

Thirdly, I did not attempt to quantify the recyclable materials taken out of Tepito by private trucks coming at night and buying directly from waste-pickers; nor from the one private company operating in Tepito. Because of these two latter reasons, the numbers presented might be conservative.

4.3.7 Writing up and organisation of the empirical chapters of the thesis

Once the data was analysed, I used the outputs to answer the research questions. The three empirical chapters each provide part of the answer to the three research questions. The way the data collection and analysis processes feed into each chapter is represented in Figure 4.5. As this diagram shows, there is no clear delimitation between the data sources and their use in different chapters. Rather, different parts of the analysis are used in different chapters. The way the chapters are divided aim to provide clarity to the reader, and to give a sense of a coherent story. Thus, each chapter addresses a different scale: the first empirical chapter (Chapter 5) looks at the governance of waste management at the Mexico City scale, and how informality is conceptualised in the discourses of policy-makers and the policy documents they write. The second empirical chapter (Chapter 6) zooms to the neighbourhood scale, and provides an overview of waste flows through the neighbourhood of Tepito. It is preceded by three vignettes, which, by presenting anecdotal stories of particular waste flows, reveal the diversity in spatiality and complexity of different waste management streams. The last chapter (Chapter 7) zooms to the individual scale, looking at the lives of selected waste handlers. This is followed by a discussion (Chapter 8) which brings these three chapters together and answers the research questions.

Figure 4.5: Linkages between data collection, data analysis, piece of writing and research question



Source: Own elaboration

4.4 Positionality and ethical concerns

The researcher has an impact on all aspects of the research process, this has been called its positionality (Flowerdew and Martin, 2005, p.113). The research topic and the overall design

of the research process is shaped by the researcher's motivation and previous professional and personal experiences (Caelli et al., 2003); the Prologue of this thesis reflects on those aspects. Another aspect of positionality, particularly relevant for empirical research, is the role of the researcher in shaping the relationship with the research participants: this includes questions of how to initiate and negotiate relationships with your participants, how to select them, or under what principles, and in which settings are interactions organised (Maxwell, 2005, p.84).

The status of the researcher with regard to the participants has been characterised in the literature as an outsider-insider dichotomy, where the researcher is either part of the community of respondents (an insider) or he is not (an outsider) - each status having particular advantages and disadvantages (Merriam et al., 2001). Yet, this point of view has been challenged by the concept of intersectionality: communities of respondents are not cohesive and cannot be defined by a single socio-cultural trait (such as gender, age or ethnicity). Identities are made up of multiple traits and evolve over time. In this perspective, a researcher may share more or less common traits with the respondents - but cannot be characterised as an outsider or an insider (Herod, 1999; Dwyer and Buckle, 2009). Moreover, the degree of insideness, or commonality with the respondents, is not a necessary condition for rigorous research (Dwyer and Buckle, 2009; Sherif, 2001). Rather, it is the quality of the relationship established between the researcher and the respondents which guarantees a rigorous approach; this quality depending not on universal rules but rather on ethical concerns (Dwyer and Buckle, 2009; Lincoln, 1995). This is particularly important due to the power differential between the researcher and the researched which produces a necessarily asymmetrical relationship (England, 1994). Therefore, it is essential for the researcher to reflect on the ethical principles used, and how they influenced the data collection process.

Although my relationships with specific participants were all different, I always followed general principles that I set myself throughout the fieldwork. Reading up on research relationships and ethical conduct before the fieldwork (Scheyvens and Storey, 2003) allowed me to define some of those principles *a priori*, while others had to be defined in the field when specific challenges arose.

Initiating contact. First impressions were crucial in establishing contact with potential participants. Being foreign, white, female, coming from a top London university, were immediate things people noticed about me, which influenced their willingness to talk to me and participate in my research. In some cases, being foreign and an outsider of local issues made people more willing to talk to me, as it was clear to them I have no personal stakes in the case-study. This was particularly true of civil servants, who may have been more wary of a local contact, writing

for a Mexican audience. Instead, I was writing in English, for a foreign audience - it is clear to me that they felt comfortable with me, knowing that what they said would not be published in Mexico. This was, however, not the case for all participants. Some agreed to participate in the research to make their point of view heard, and were eager to see the results published in Spanish and available in Mexico, so that the research could have an impact in how waste management is organised.

Being different (foreign and female, with generally male participants) also ignited participants' curiosity, they felt eager to have a chat with me, and were generally interested in my research. However, this interest did not mean that they decided to participate in the research in the end. In some cases, people were interested in having personal chats with me, but this did not always translate into accepting to conduct an interview.

Indeed, how friendly to be was one of the central questions around my relationship with participants. On the one hand, everybody was very friendly - I was not surprised by that, as I perceive my relationships in Mexico to be generally friendlier than in other countries. Besides, it did not seem to have a direct impact on the research - it just seemed to be the natural way to relate to one another. Thus, at first it appeared normal to have informal chats with participants about topics beyond my research. Friendliness also grew naturally with the family of the owners of the recycling shop where I conducted an ethnography, and sharing details about my private life was part of an exchange where I could learn about theirs.

On the other hand, I was aware that the reproducibility of research might be undermined if friendliness played a part in data collection. More importantly, I was uncomfortable with the idea of *having to* be friendly in order to create a fruitful relationship - male participants were particularly insistent in this regard. My decision as to how to handle these situations, was to generally answer the questions I was being asked about my personal life. However, I would only do it when prompted on the topic, and would try to go back to the topic of waste management as smoothly as possible. I never spontaneously talked about myself or the participant's personal life as a way to establish a working relationship. I also turned down invitations to lunches, dinners, parties with participants, even if that may have helped me to get interviews more easily.

Consent. Once participants accepted to take part in the research, gaining informed consent was the first aspect of their participation. Consent was not asked through the traditional consent form (as advised by the UCL ethics committee), for two main reasons: In Mexico City, generally, and in Tepito particularly, contracts are usually agreed on in an oral rather than a written form. This may be due to the informal nature of the neighbourhood. The second reason is that some of the research participants could not read or write. As I did not know in advance who could read and

who could not, I preferred to ensure I would always explain the information sheet orally, and take the time to make sure people understood. Consent was then asked for orally as well.

As the data collected was of a sensitive nature, explaining the research process and the participant's rights was crucial. I spent time explaining the objectives and outputs of my research carefully, as well as the potential harm to the participants and what steps I had taken to mitigate it. This is explained in the upcoming paragraph on safety of participants.

Participation was voluntary, and was not remunerated. It is only in the case of the informal waste-pickers, the most destitute of my interviewees, that I offered payment in exchange for participation: as time is all they have and they spend all their day working, I felt that it was fair to pay them the same amount that they would have earned if they had been working instead. I offered 40 pesos (2.4 USD) for a one hour interview - yet, all but one interviewees refused to take the money.

Mutual respect and reciprocity. The general principle that I followed throughout was one of mutual respect. I treated the research participants as equals, and particularly tried to ensure they were not feeling used by me, but that the relationship was one of exchange, thus undermining the power differential between myself and the research participants. This exchange took different forms with different people.

Some participants were civil servants and experts - my interaction with them was limited to a one-off, one hour interview. They were generally interested in my topic but also very busy. Therefore, in my view, achieving respect and reciprocity entailed explaining them carefully the research process, act professionally, not take up too much of their time, show interest and gratitude for their information and time, and offer to share my results with them. The contact was generally a one-off, but I ensured each of them had contact details, should they wish to contact me later.

My relationship with waste handlers was different: firstly, I spent months doing fieldwork in a small neighbourhood, which means that I saw them on a daily basis. My interaction with them consisted of single or several interviews, informal chats, and observations, through a longer period of time. Most waste handlers tended to have time to chat, and enjoy it (some waste-pickers suffered from social isolation). Therefore, in this case, respect and reciprocity were achieved by taking the time to learn about the socio-cultural context, act accordingly and show gratitude to the participants. Whenever I could help participants in any way that would (at least partly) reciprocate their help to me, I always did. I helped a street leader with a text he was writing, and I helped out with the daily work in the recycling shop where I was observing

on particularly busy days. In all cases, I thanked participants for their help, ensured they had a way to contact me and that I would share results if they were interested.

Safety of participants. The foremost principle that was guiding my actions was to ensure the safety of people who chose to participate in my research. The research deals with sensitive topics (informal and illegal activities, relation with government, including extortion, among others). Although informality is not the same as illegality, there is an overlap in the Mexican context, particularly with regard to corruption. Thus, it is essential to ensure the anonymity of participants, so that their engagement in informal activity cannot be inferred from the thesis - which would put them in a vulnerable position towards the local authorities. The process of anonymisation is relevant at various stages of the work. It mainly takes place at the writing-up phase, where I used pseudonyms instead of real names, and I made sure to not include sufficient personal information about participants so that they could be recognised. In one particular case, this question of anonymity came up at the data collection stage: I was interviewing a participant who was providing me information with regard to the illegal activities of his employer (including the indignant exploitation of his workers). Considering that the employer was aware of my interviewing his employee, and his interest in reading the thesis once it was written, it was clear that he would be able to recognise the interviewee, despite any anonymisation method. I thus considered that participating in the research was ultimately putting the interviewee at risk of being fired or violently intimidated by his employer - I therefore decided to stop the research relationship with this particular participant. As a result, his story (and what he told me of it before the relationship stopped) is not a part of the findings of this thesis.

Safety of the researcher. I took steps to ensure my own safety. First, I never went into people's homes, only in their workplaces (which is why I did not conduct observations or interviews with regard to household waste disposal). This is an example of how my positionality shaped the research design, as my perception of safety restrained the focus of the research to public and semi-public places.

In addition, someone always knew where I was, and the name and address of the person I was going to see (this information was never made use of as I never had any issue). Beyond this, I learnt during the fieldwork, as I was getting to know the neighbourhood, which activities were safe for me and which were not. I therefore decided to hire a research assistant, who is a friend born and raised in Tepito. He accompanied me during specific parts of the fieldwork. Firstly, he accompanied me when I carried out fieldwork at night. This was the case when interacting with the street sweepers and the municipal waste collection crew, who work mostly in the late evenings and early mornings. Secondly, he accompanied me during the survey,

which entailed walking around each and every street of the neighbourhood and talking to many different recycling shop workers, as well as when I was looking for new participants. In both cases, he was very helpful, both in knowing which areas of the neighbourhood might have more recycling trade in them, who I might be interested in talking to, and helping me establish the first contact with participants. Thus, although concerns for my safety started as a barrier to conducting fieldwork, the way I decided to mitigate it became a strength, as having a research assistant who was also a local was very helpful in getting to know the neighbourhood and gaining access to a range of participants.

4.5 Conclusion

This chapter has delineated the methodology adopted. The research design is qualitative (although it makes use of a quantitative survey) and involves mixed methods. One way to ensure robustness in qualitative research is to explicitly reflect on the epistemological position of the researcher and how this shapes the research design (Roulston, 2010). This chapter has shown how the overall research process is shaped by a social constructivist perspective; this is determinant in the decision to document multiple perspectives on waste management rather than producing a "synthesis" of one objective reality. The social constructivist perspective emphasises the subjectivity of the knowledge production process, which produces necessarily subjective accounts of the social world. Indeed, Chapter 3 has shown how current waste data for Mexico City emerges from a research framework that excludes the informal economy. This expert knowledge can therefore be challenged by contrasting it with alternative knowledge claims. The rest of this thesis aims to perform such an exercise with the topic of Mexico City's waste management. Chapter 5 critically assesses the official data which is the basis of Mexico City's waste policy. This will then be contrasted by documenting the perspectives of a range of waste handlers in Chapters 6 and 7.

Chapter 5

Waste governance and the production of informality

Chapter 3 emphasised one paradox: while there is a consensus in government and academia alike that informal actors do participate in urban waste management, they remain absent in the policy and planning process. This paradox informs the overall research aim of this thesis, which is to learn more about the contribution of informality to Mexico City's waste management system. In this first empirical chapter, I analyse the political construction of the concept of "informality" by civil servants in the context of urban environmental management.

Informality is a concept that civil servants co-construct through their discourses. Although these discourses are diverse, one discourse is particularly dominant - within this discourse, informality is portrayed as a barrier to the country's development. In fact, informality is constantly being put in opposition to ideals of modernity and sustainability. While the first section of this chapter analyses these discourses in-depth; a second section takes the most recent waste management programme as a case in point, and analyses the construction of informality within it - and the implications for the strategies put forward. Lastly, a third section looks at the impacts a particular informality discourse at the micro-level of waste collection: by looking at the case of Tepito, I argue that the municipal distribution of resources is affected by the dominant discourse - this not only determines the quality of the waste collection service, but it also subsequently influences local relationships between civil servants and citizens, which affects practices of waste separation.

5.1 Institutional discourses on urban informality

This section critically analyses the discourses of civil servants and experts around the role of informality in urban environmental management; it reveals the diversity of ways informality can

be conceptualised and how these diverse conceptualisations are mobilised in narratives about what makes an ideal society.

5.1.1 How do policy makers conceptualise urban informality?

Interviewees present contrasting and at times contradictory claims as to what characterises urban informality, both in terms of its impacts and extent in Mexico City; indeed, their perceptions reflect the academic literature insofar as informality is portrayed as a controversial term,[1] being used to portray a wide range of realities.

Some interviewees explain that informality is everything that is not planned by the government. While not feeling confident to quote exact numbers, their intuition is that the majority of processes in the city can be labelled as "informal" (not taxed, not monitored by the government, outside of planning processes) and thus the city could not function normally without these informal processes. Particularly, the informal economy contributes to the provision of everyday goods and services (housing, jobs, food) where the state fails to do so. Urban informality plays an essential social role both on the supply side (providing jobs) and on the demand side (providing affordable goods and services), and is therefore seen as necessary to the life of the urban poor. As interviewees put it, the informal economy acts as a "social buffer" (Mun1, Feb 2015) or a "pressure valve" (Exp 3, Feb 2015 and Inst2, Feb 2015).

On the other hand, other interviewees downplay the role of informality in making the city function. These interviewees generally do acknowledge the incapacity of the state and the capitalist market to provide housing, jobs and everyday goods to all urban dwellers. However, they argue that the main reason for choosing to participate in informal activities is because it might offer more attractive alternatives than the formal market (rather than any alternative at all). By this, some interviewees mean cheaper production costs (through tax evasion), higher wages (due to a very low minimum wage in Mexico) or generally more freedom from business regulations and bureaucracy. These interviewees frame the action of engaging in informal practices and transactions as breaking the law in order to benefit from better opportunities. In that sense, this second group relates informality with illegality, as the following extract shows:

"Everybody complains. But we're also partly accomplice... [...] It's a bit like what happens in Colombia and in Mexico with drug trafficking. Somehow, there is a network. [...] Everybody knows someone who works in drug trafficking... so we can't really be against it." (Cit3, Feb 2015).

[1] Interviewees tended to rely on personal stories and anecdotes, rather than official statistics or reports, in order to make their point. This was rather surprising considering the extent of academic and grey literature being published on informality in Mexico.

The interviewee is explaining why informality is so prevalent in the city, and actually compares it with drug-trafficking, an illegal activity which is the cause of a conflict between the military and cartels and at the origin of many deaths and violence in Mexico. This is a very different understanding to that of the interviewees aforementioned, who highlight the role of informality in providing everyday necessities to the urban poor. The observation is similar with regards to organised informal groups. One interviewee describes them as follow:

"[Informal] waste-pickers are a very tough sector. They are a Mafia. Really, they are a Mafia. There is data that I can't corroborate myself which even says that organised crime – there is so much money moving in the waste sector – that even organised crime is linked with the waste sector. Yes, waste-pickers really are a Mafia. Some are part of union, some aren't, but in any case they have the police on their side." (Cit1, Feb 2015).

In this account, the organisation of informal workers seems to be against the law and quite different to how a formal business would be organised. However, an expert challenges this perspective, explaining that this process of organisation into a powerful syndicate is not specific to the informal sector. Whether the group is formal or informal, the politics are the same, and rather than a Mafia, this can be described as a corporatist system.

"Corporatism comes from the Mexican revolution; it has existed for over seventy years. [...] It comes from fascism because in the first year of the Mexican revolution, the corporatism model was imported from the Italian fascist regime, which had work corporations, that is to say, all workers belonged to a single union, and benefited through the union. [...] In Mexico, professional activities have remained within this corporatist system in which workers have certain benefits, such as the railroad workers, electricians, government employees, the self-employed... [...] What there is, is an automatic representation of workers in the workplace, which works vertically and in an authoritarian way. [...] In many sectors that aren't formal, the vertical structure tends to be the same. For instance, these leaders of the Historic Centre's street vendors, and elsewhere, are those that hold all their workers' licenses to occupy public space. And their treatment of the workers is very authoritarian." (Exp4, Feb 2015)

The interviewee explains how informal activities reproduce organisational systems of the formal system, which are inherited from Mexico's political history. Rather than comparing informality with a marginal or illegal practice, the interviewee compares it with institutional, public service companies. Indeed, most interviewees pointed out to the relationship between informality and corruption - "it's one and only system" was a common phrase to reflect this idea (and the phrase used by most interviewees throughout the interviews). What this sentence means is that informality exists because it is tolerated by the state (if not, it would be pros-

ecuted as other illegal activities). This tolerance can be explained both by the recognition of the essential social role that urban informality plays (in terms of providing affordable goods and services), and by corruption. Informality is tolerated by government employees because they personally benefit from it through the collection of bribes (by employees at lower levels of governments) and political support (by political parties at higher levels of governments). As one representative of Mexico City government puts it, the relations between the local government and informal workers follow the rule of clientelism: "I'll give you an opportunity [to work informally], in exchange for your vote" (Cit4, Feb2015).

All interviewees associate, to some extent, informality with corruption and corporatism. Their characterisation of informality diverges, as discussed above, in terms of its contribution to urban life. Could this difference between interviewees' perceptions be explained by the diversity of informal activities that take place in the city - and their heterogeneity? Interviewees may characterise informality in different ways because they have different informal practices in mind.

Indeed, interviewees draw on examples from a diversity of informal activities: they mention domestic work, the construction sector, small manufacturing, micro-businesses (for instance "tienditas", which are small corner shops), street vending, as sectors with many informal workers. In addition to the diversity of activities present in the informal economy, interviewees mention highly differentiated levels of organisation among its actors. At one end of the spectrum are the less organised informal practices such as informal housing or small business owners. In this case, informal actors are generally not organised among themselves and have little communication with government. At the other end of the spectrum, informal public transport and waste management are sectors where informal actors are very organised and have played a historic role in urban politics (through the corporatist system) (as described in Chapter 3). In this case, the level of interaction with the government is high.

Yet, I would argue that the divergence in interviewees' portrayal of informality cannot be explained by such heterogeneity. Although interviewees display a knowledge of this diversity of informal practices and contexts, they also emphasise the need to be specific when characterising informality. Rather, what this diversity of views reveals is that interviewees' vision of informality is not fixed - it emerges from a constant re-imagination of the phenomenon of informality. This is particularly true when visions of informality are mobilised within a wider normative discussion as to desirable visions for the future of the city. In order to contextualise such a discussion, the following section explores how interviewees perceive the contribution of the informal economy to the city's sustainability - this leads to a discussion, in the following

section, of how the visions of sustainability held by interviewees shape the way they conceptualise informality.

5.1.2 In what sense does informality contribute to sustainability?

Looking at informality in relation to sustainability, the divergence between interviewees' views appears more clearly: to grossly summarise, urban informality is seen by some interviewees as an important factor in Mexico City's current functioning and potential sustainability, while others see informality as a barrier and a threat to the same end. However, there is a general consensus between interviewees on some key points.

Particularly, all interviewees agree that informality is a crucial topic in environmental management and more generally urban sustainability. This is because it shapes urban life, in particular how decisions are made in the city, as well as how people consume and how materials move around and are traded in the city. Some activities, such as informal domestic work for instance, although marginally mentioned, are not seen by interviewees as a sector that influences (by its characterisation as informal) urban environmental management and sustainability. On the other hand, some sectors of the informal economy influence urban sustainability by their mere characterisation as informal: for instance, informal public transport, by not complying with environmental regulations, can use motors that are older and more polluting than in the formal public transport sector. In this case, informality thus has a direct impact on urban sustainability. The interviewees mention informal housing, street vending, public transport and waste management as key sectors where informal transactions play an important role. These are thus the sectors included in the discussion of the topic of urban informality in relation to urban sustainability from this point on.

In this section, I start by reporting the interviewees' perceptions around the contributions of informal practices to urban sustainability. I organise the findings around the four pillars of sustainability, which are the environment, the economy, society, and governance. The diversity of informal practices means there are multiple positive and negative implications in terms of sustainability, and that opposite implications are possible. These impacts are presented below and summarised in Table 5.1.

Economic impacts. In terms of economic impacts, four out of fifteen interviewees mention the benefits of the informal economy in terms of job creation. Indeed, the benefit is double, as many (unskilled) jobs are provided within the informal sector, and these jobs provide essential services to the city (street cleaning, gas and water vending, transport, waste management, food vending, etc.). However this effect can sometimes overshoot, as there can be congestion in service provision (for instance, too many taxis or buses competing for clients can be unproduc-

tive); and there is an unfair competition to formal businesses. This is mentioned particularly in the case of street vending. On the other hand, nine interviewees mention the loss incurred to society as a whole (and government more specifically) that occurs when a public good is privatised for individual gain (for instance, when public space is used for street vending), and no public benefit is gained from it (not even through tax-paying). This is just an example of a public good that is monopolised by informal actors: other examples are water and energy theft by street vendors, loss of tax revenue, or loss of recoverable recyclable material through informal waste picking.

Social impacts. In terms of social impacts, the benefits are similar to the economic ones: informality acts as a buffer space where urban dwellers can provide for their needs when unable to do so in a formal context. As such, interviewees highlight the provision of housing, jobs, healthy food, everyday goods, services (public transport, credits and loans) in an affordable way within informal markets. Negative impacts relate to the conditions of workers within the informal economy, where the working conditions might be dangerous (particularly for waste pickers). Five interviewees also argue that working within the informal sector furthers one's condition of poverty and does not allow for an improvement of one's socio-economic condition.

Environmental impacts. In terms of the environment, the impacts are once again varied. Positive impacts mentioned by interviewees have to do mainly with waste management. First, by promoting re-use and repairs of consumer durables (such as appliances, electronics, furniture or clothes), the informal economy diverts waste from landfill. Informal waste picking activities involve the separation of waste and the recovery of recyclables through their sale to the recycling industry. More generally, informal activities are labour- rather than technology- intensive, and tend to re-use waste as inputs into new activities, which make it energy and resource efficient. However some informal businesses might not comply with environmental regulations, thus polluting more than their formal counterparts (for instance, informal bus operators might not have the adequate motors and thus contaminate more than legally allowed); they could also produce more waste and participate in waste dumping (the construction sector is known to dump non-recoverable waste illegally in different urban sites). An interviewee also mentions water and energy theft which is common in informal homes and street stalls that have no legal access to these urban services. This, according to the interviewee, is a reason for users to over-use and potentially waste energy and water.

Governance impacts. Governance impacts are also mixed. Organisations of informal workers are observed to bring order and stability to certain economic activities. Two interviewees describe them as governance that is authoritarian yet efficient (for instance, public transport

leaders plan all the private bus routes and their operation). However, eight interviewees also strongly associate these organisations with practices of corruption and clientelism, comparing them to a Mafia; practices which reduce the potential for good urban governance. Urban informality is more generally associated with a variety of crimes and illegal activities (theft, piracy, arms and drugs sales, etc.).

Table 5.1: Summary of the sustainability impacts of urban informality identified by interviewees

	Positive impacts	**Negative impacts**
Economic	Job creation, Service provision, Makes urban processes run smoothly	Congestion of service provision, Unfair competition to formal businesses, Loss of tax revenue, Privatisation of public goods (space, recoverable waste), Water and energy theft
Social	Provides livelihoods, Promotes social cohesion, Affordable supply of everyday goods, Affordable supply of services (transport)	Bad conditions of health and safety for informal workers, Informality potentially furthers urban poverty
Environmental	Reduction of waste through repair and reuse, Efficient waste separation and recycling, Efficient use of public goods (for instance land through dense housing), Prevalence of small scale, low-tech agriculture means less chemical use	No compliance with environmental regulations, Environmental dumping (old motors pollute the air, water is contaminated), No energy efficiency, Can produce more waste than formal businesses
Governance	Informal organisations bring order and stability, Informal actors do organise and get representations in a way other marginalised groups do not	Informality is associated with corruption and clientelism (Mafia), Prevalence of crimes (theft, piracy, arms and drugs trade, etc.)

Interviewees highlight the trade-offs between different pillars of sustainability. Particularly, the case of waste is presented as one where environmental impacts are thought of as positive (through efficient waste reduction and recycling) however the social and economic implications are negative, both in terms of workers' health and safety and loss of revenue for the government.

Despite the analysis in terms of sustainability impacts being useful for a first description of the interviews' content, it is not really representative of interviewees' narratives as they do not only think in terms of the sustainability impacts of informality. Rather, informality is thought of as an inherent characteristic of urban life, which has origins and root causes, positive

and negative implications in terms of urban sustainability, and that can be dealt with through different policy pathways.

5.1.3 Analysis of informality discourses

In this section, I move away from looking at the interview content according to themes, and I rather identify and analyse the discourses that the interviewees develop.

"Resilience" versus "illegality": Two opposing visions of informality? Two groups appear based on their understanding of informality, which correlates with two policy alternatives. These groups seem to aggregate around the two discourses on informality discussed earlier in this chapter. On the one hand, some interviewees (those who characterised it as a "social buffer") view informality as an essential part of the city's resilience, and as a key factor in the city's sustainability. These interviewees tend to favour policy options that entail the incremental formalisation of informal practices. Five out of fifteen interviewees correspond to this description, it is therefore a minority of interviewees. Four out of these five interviewees are either civil servants at the federal level or experts (the fifth being a municipal employee); they are therefore more formally educated and tend to hold strategic positions in the government - this means they are removed from the everyday operation of urban environmental management. On the other hand, other interviewees view informality as problematic and as both a cause and consequence of urban poverty. In this understanding, informality hinders the city's development and should thus be, in the long run, eradicated. These actors favour policy options of modernisation of the economy through prohibition or formalisation of informal activities. Eight interviewees adhere to this discourse (although three only to a certain extent), most of which work in the Mexico City government, which means they hold position where they design and implement the city's strategy as to urban environmental management. These two visions and the main messages associated with them are summarised in Table 5.2, and are then explored in more depth.

The group with a discourse labelled "resilience", sees informality as a characteristic of contemporary urban life. One government employee phrases it this way, relating resilience to complexity:

"Cities are complex systems [. . .]. And the difference between a simple and a complex system is that a complex system keeps on functioning even when some of its parts fail. And this is what makes informal processes appear in Latin America. It is because sometimes formal systems do not supply some things, and thus all that informality emerges. There is no formal answer to the employment problem, therefore there is informal employment." (Fed1, Feb. 2015)

Table 5.2: "Resilience" and "Illegality" as opposing visions of informality

Vision of informality	Resilience	Illegality
What is informality?	Informality is everything that is not planned by the government, that is to say, the majority of urban processes.	Informality is a problem for the city as it makes the city less competitive; and is a symptom of underdevelopment and poverty.
What are its root causes?	It emerges as a response to state failure in relation to job and service provision.	It emerges because of tax evasion, and generally people not wanting to modernise.
What is its role in urban life?	It contributes to the city's resilience: it makes the city work (based on traditional knowledge, skills and culture).	It is hindering the city development, because it is not organised or manageable. It is a threat to the rule of law.
Sustainability impacts?	Mainly positive: Waste recovery, promotes small scale local farming, provides cheap healthy food and everyday goods, provide jobs	Mainly negative: pollution and high waste generation, exploitation, not-accountable governance system, tax evasion
Informality policy options	Promote informality, learn from it, improve working conditions, mitigate potential negative impacts and generally work on creating jobs (as a national policy)	Authoritative enforcement of existing laws, modernisation of the economy, integration of informal actors into the market
Interviewees with this discourse	Exp1, Mun1, Fed1, Fed2, Fed3	Cit1, Cit2, Cit3, Cit4, Fed4, and to a certain extent, Mun3, Exp3 and Exp4

This is expressed in a different way by another interviewee: *"I consider that there are two Mexicos: the official Mexico and the Mexico that functions on its own, without government intervention"* (Mun1, Feb. 2015). In this sense, informality emerges to provide the services that the formal institutions (such as the state or the market) fail to provide (primarily jobs, housing and everyday goods). This is why informality is associated with resilience: because it makes the city work by creating redundant systems that facilitate access to services and products in a more inclusive way. Informality does not work independently or in parallel from formal systems. Rather, informality sustains formal systems: workers who earn low wages within the formal economy depend on the informal economy to feed themselves or buy affordable clothes. This is a similar approach to that of Friedberg (1997) and Adler Lomnitz (1988) (described in the theoretical framework) who define informality as the uncodified processes which directly sustain any formal system. One example given by two interviewees is that of mall employees who cannot afford to shop within the mall that employs them due to low wages – they are primary consumers of informal economy products. This has also been described in the literature (Duhau

and Giglia, 2007). In this narrative, the sustainability impacts of the informal economy are thus mainly positive as the economy that it promotes are family businesses and subsistence activities, which are usually energy-efficient (by being labour- rather than technology-intensive). However, the interviewees do acknowledge the hard toll on workers (exploitation within informal networks, difficult and dangerous working conditions, lack of social benefits) as negative social impacts of informality. The policy options favoured by interviewees with regards to informality are those that promote the incremental improvement of working conditions and mitigation of adverse environmental impacts (without an automatic formalisation strategy). Additionally, it entails acknowledging informality's positive contribution to urban life and learning from informal practices when relevant, as the following quote shows:

"[Within informal processes] I think there are very logical sustainable practices that we ought to re-use, to make use of those resources which emerge in an informal way. Thus I think the problem is that we try to make the informal sector fit within our logic of formality, rather than understanding these informal processes and using this understanding as a starting point in order to rethink our public policies." (Fed1, Feb. 2015)

Additionally, as informality is associated with state failure to provide jobs, housing and services to all urban dwellers, one long-term solution to the problem is to increase government investment in job creation in order to gradually reduce the number of urban dwellers who have no other option than finding employment in informal markets. This would have to be accompanied by an increase in the minimum wage, so that workers could make a decent living within the formal economy (Exp4, Feb. 2015).

Interviewees who tend to associate informality with "illegality" (a minority of interviewees but the biggest cohesive group) start with a different understanding of the root causes of informality. They frame the action of engaging in informal practices and transactions as breaking the law in order to benefit from better opportunities. For instance, street vendors refuse to become sellers as part of an organised public market because they would have to pay a rent and taxes to the state. This, interviewees argue, can be explained by one aspect of the Mexican culture, which is the refusal by some citizens (both on the supply and demand side of informality) to "modernise" and follow the rules of a democratic, developed society:

"It's about modernising [the country's economy and politics] without first having modernised culturally and intellectually. [...] I think it happened differently in Europe. Europe first was modern. And then it modernised: technological and economic modernisation came later. But first, they were erudite. First was the French revolution. First was freedom, was equality, human rights, and only then came economic modernisation. Here on the other hand, we got economic

modernisation first, and we are still thinking in a very medieval way, to exaggerate a bit. It might be that we are modernising politically, but our ways of thinking are still through [...] corporatism, cronyism, things like that, very crappy. [...] So when you modernise the politics, you get into trouble because you cannot implement it, because the people keep on thinking like yesterday. [...] This is a topic that is existentially cultural. I'm telling you, it's like everything can be justified by this idea of 'this is who we are; this is how we deal with things'. We have to change our whole vision." (Cit4, Feb. 2015)

In this extract, informality is associated with a backwards way of thinking which is problematic as it hinders the city's development, and the success of innovative urban strategies. One example (taken by Cit3) is tackling air pollution, which is difficult to do if informal bus and taxi drivers refuse to upgrade their motors to more efficient ones. Thus, informal activities are seen as having generally negative sustainability impacts, characterised by pollution, adverse working conditions (in this sense they agree with the "resilience" discourse) and the loss of capacity to govern on the part of the state. The policy option that is proposed by these interviewees is thus one of law enforcement, where authority is used in order to ensure informal actors disappear either through prohibition or formalisation strategies. When asked to describe a successful policy response to informality, an interviewee mentions:

"A 'strong hand' policy ["mano dura" in Spanish, T.N.]: in Tepito there was an authoritative policy. It involved entering [police entering the neighbourhood, T.N.], and expropriating a whole zone of Tepito which was known to be where activities related to delinquency were taking place. Well this was an authoritative act which was fully justified, which did not require any negotiation but rather taking action. [...] If someone steals electricity or sells drugs, it is necessary for the state to act and make sure this stops, and there are not many ways to do it besides acting with the full weight that authority gives you... this is why citizens vote you in, so that, among other things, you provide this certainty in terms of security which implies being governed". (Fed2, Feb. 2015)

Referring to informality as illegal practices that may threaten public order (the security of citizens), the interviewee justifies the use of authoritative measures against informality. Other policy options such as negotiation are not considered viable because informal actors are seen as a "Mafia", thus the government cannot negotiate with them. One consultant in charge of the design of a sustainability strategy says the following:

"Interviewee: We even tackled governance; we wanted to touch upon the informal sector. But it was something where we were told: 'Don't even try to meddle in their business, it's a complete Mafia'.

Interviewer: Who said that to you?

Interviewee: The people from the Mexico City government. [...] We realised that Mexico City government does not have much leeway because the municipality is responsible for dealing with them.

Interviewer: They told you to avoid meddling in their business because the Mexico City government does not have authority to do so?

Interviewee: No, they don't. It's a very high political cost that nobody was ready to pay. What I mean is, a political cost in terms of votes, of credibility, appearing as an unjust government. [...] The government really cares about this, the perception of people, even though this perception might be mistaken. This is why they don't do anything." (Cit1, Feb. 2015)

This refusal to negotiate can be explained by the political cost associated with negotiating with Mafia-like organisations. In order to promote long-term good governance, it is thus necessary to deal with rogue actors (that are informal actors) with authority.

It appears that the policy options which are considered effective are not the same in the two main discourses identified in the interviews. The understanding of informality and its root causes shapes the interviewees' view as to which policy options are viable. This seems to also be correlated to other things, such as the interviewee's general vision of an ideal society as well as the related sustainability pathways that are envisioned to achieve this vision (but more on this in Section 5.1.4).

Going beyond the dichotomy: a diversity of narratives. Although the dichotomy between the two visions ("resilience" and "illegality") emerged from a first analysis of the interview transcripts, a finer analysis revealed that this classification only fits slightly over half of the interviewees. Others present a somewhat more complex view of informality and its role in urban life. It is thus necessary to extend the analysis in order to characterise the narratives of these other interviewees.

Three interviewees (Exp3, Exp4, Mun3) fit only partially the vision of informality as illegality. They do see informality as a negative force in the urban area which is threatening the rule of law. Yet, they argue that the root cause of informality is state failure, that is, the inability of the state to provide enough jobs and affordable goods. They thus advocate for strong employment policies, and to raise the minimum wage. To summarise, although they do not see informality as contributing to sustainability or urban resilience, they do favour a preventive policy option rather than one of prohibition, in that sense resembling the "resilience" discourse.

On the contrary, one interviewee (Inst2) fits to a certain extent the "resilience discourse", as he believes that informality has rather positive sustainability and resilience impacts. However

his policy view is market-oriented: without suggesting automatic formalisation, he proposes that informal actors organise and create micro-enterprises and cooperatives in order to permeate formal markets. Another interviewee (Exp2) is also tangentially fitting the "illegality" discourse, by seeing informality as problematic and something that should disappear in the long run. However, his high awareness of informal waste-pickers' role in Mexico City gives him an understanding of informality as being essential for the city to work, particularly in the case of recycling (with the positive role of informal waste-pickers).

The previous three examples show that there is no automatic correlation between understandings of the root causes of informality and associated policy options, and discourses can be more complex than what previously appeared.

Additionally, two interviewees (Mun2, Inst1) fit a completely different understanding of informality, which could be classified as "pragmatic": Throughout the interview they never characterise informality as positive (contributing to resilience) or negative (illegal); rather, they adopt a more pragmatic approach and instead of suggesting hypothetical policy options, they describe their work with informal actors, negotiating and working on a case-by-case basis as they would with any other actors, in order to implement their sustainability strategies. They take a different stand than Cit1, who would not negotiate with politically-organised informal actors. In this case, the interviewees carry out successful negotiations by by-passing the leaders and addressing all relevant informal workers. As one interviewee explains, the government can negotiate with informal actors as with any other because they are actors in the city, with stakes and interests; and they have a history of informal negotiations with the government, which is a precedent for successful partnership. When describing a successful environmental programme involving informal street vendors, an interviewee explains:

"One of our colleagues went to street vendors and told them, "there will be a meeting and you are invited"; it was here in the auditorium, and we talked with everybody. We explained to them what we are doing with [formal] public markets and we invited them to help us in reducing water pollution. We explained to them why it's important to manage waste properly. [. . .] One person came from each street stall. We have the capacity to summon them, and they do not ignore us, because the government grants them tolerance, some of them have a permit from the 1950s - for street vending. They are registered in the government's public registry, and they do acknowledge the municipality's authority, so we summon them, it is feasible, and this idea of a pilot project, we consider it is viable, with many other informal street vendors as well." (Mun2, Feb. 2015)

This extract shows that although some interviewees do feel that negotiating with informal actors is not an option, others do not and carry out projects in cooperation with informal actors. This is observed within a municipality, but also in the example of a cooperation between an international institution, the federal government and a rural locality (Inst1). These examples show that there is a precedent of enhanced capacity to govern when political actors do engage with informal actors - challenging the claims made by proponents of the illegality discourse.

5.1.4 Informality discourses and visions of an ideal society

It appears that there is a correlation between an interviewee's portrayal of informality and other factors, such as favoured policy alternatives with respect to informality. In the interviews, I also observed a different correlation, which is that between participants' portrayal of informality and their vision of an ideal society (to put it in a different way, a "desirable future") generally characterised as developed, modern and sustainable. Therefore, in this section I explore the co-construction of informality discourses alongside discourses of an ideal, modern, developed and sustainable society.

Sustainability visions. As discussed in Section 2.2.2, sustainability is a contested concept, and different visions coexist in the political arena. One assumption that plays a major role in distinguishing two major discourses, is that of the compatibility of ecological preservation with economic growth. Proponents of the green growth discourse argue that the two are compatible, and propose a vision of sustainability where economic activities can contribute to the protection of the environment, through investment in eco-friendly technologies. At the other end of the spectrum, green radicals perceive economic growth to be incompatible with a sustainable state of society, and as such, argue that in order to preserve the environment, it is necessary to rethink the capitalist economic system.

The interviews' analysis reveals that all interviewees adhere more or less closely to one of these two discourses. Furthermore, favouring a particular vision of sustainability appears to shape how interviewees think about the topic of informality. When prompted to describe an ideal, sustainable society, interviewees who portray informality as "illegality", adopt a discourse of green growth, while those interviewees who portray informality as "resilience", propose visions of an ideal society which belongs to the visions of "green radicals".

When asked about the key levers of a sustainability transition, the first group of interviewees mentions investment in clean technologies, involvement of the private sector, and generally a modernisation of the country's economy and infrastructure. For instance, one interviewee explains what he thinks is the key policy to achieve sustainability:

"It's a very difficult question because I wouldn't cite just one. [...] One of them is, for instance, waste management. Nowadays there are technologies to recover a hundred percent of waste, while generating a profit. [...] Everybody [needs to see] the advantages in recovering, processing, and recycling one hundred percent of our waste, sharing the profit in an organised way, and obviously, in involving the private sector." (Fed4, Feb 2015)

The interviewee goes on to proposing the investment in energy-efficient public lighting, which could be achieved through a privatisation of this service in order to benefit from the investment capacity of private utility companies. What is striking is that this vision (which can be associated to green growth) is proposed by interviewees who have a particular discourse on informality, which is the one described earlier as the vision of informality as "illegality". Indeed, this particular interviewee is the same who also proposes to deal with informal actors through authority and eradication (see quote p.135, Fed2). In his view, informal actors are a barrier to sustainability because they are resistant to modernisation. They have the capacity to organise in groups, and through corruption and lobbying, further their own self-interest (for instance, by resisting investments in new technologies). Cit3, for instance, explains the case of the formalisation of a bus route (to introduce eco-friendly buses) in which he was involved:

"The trick was to integrate the informal workers. How did we do it? We talked with the real leaders, not the ones who exist on paper, but the real ones. We told them: 'Look, there are two business alternatives: you have two companies, one is working without contracts, without maintenance, disorganised' - we told them the reality of it! 'you invest that much and you earn that much. What we offer you is to move from this, to a professional company, with contracts, social security, retirement plan, with training for the drivers, with maintenance done in proper, formal workshops - not in the street, alright? With such a well organised company, you invest this much, and you earn this much - which company do you think earns more? The organised company earns more, this is logical!'. This was the thing, to tell them: 'you are doing this in informality, you lose a lot of money because you have a terrible business plan. Formalise it, you will earn more'. We convinced them, and that is how we established [the new bus route]." (Cit3, February 2015)

In this story, like in the previous one, sustainability is achieved through the investment in clean technologies (in this case, eco-friendly buses). The synergies between protection of the environment and economic growth are clear (in the interviewee's view): investing in the public transport system is a way to bring about cleaner technologies (the eco-friendly buses) and at the same time to modernise the organisational system of the transport companies, which increases their profit. Informal workers were, at first, resistant to modernisation, because they *did not*

understand the economic benefits that modernisation entail. Thus, the solution is to educate them, to explain them that formalisation (in other words, the eradication of informality) is the best way forward, in economic and environmental terms.

Yet in other cases, informal workers may not be this easily convinced. If they disagree with a modernisation plan, interviewees feel that they have the power to tear it down - informal actors are powerful because of the corruption links that they have established with the government and therefore, they are a threat to traditional, top-down planning. Thus, for another interviewee (and a colleague of Cit3), a necessary condition to achieving a sustainable society is to curb the power of informal groups. As she explains:

"In Mexico City, it is necessary to take extreme actions to achieve a technological leap [...] to use aggressive policies, aggressive regulations in terms of urban planning. And look: it would be essential and phenomenal to eliminate the conflicts of interests. Because Mexico City already has many norms and laws, it has so many things already, to be sustainable. [...] But the conflict of interests that exists between the private sector, principally, and the corrupt politicians, has not allowed for the existing norms and laws to be applied. [...] So I think that a strong policy in terms of climate change, or sustainability, would be to really apply urban planning regulations, and to clean the Mafia out, and the conflicts of interests... so that what is already there, can be applied." (Cit1, February 2015)

In this extract, the interviewee does not explicitly identify the informal sector in relation to corruption and conflicts of interests. Yet, in another extract of the interview (see p.127, Cit1), this same interviewee describes the informal sector as a Mafia, and as having "the police on their side", referring to corruption. Thus, in this view, informal actors, by engaging in corruption, create a conflict of interest for politicians, which entices them to take decisions which are not always the best in terms of urban sustainability. In this sense, a key aspect of achieving sustainability is to eradicate informality and corruption.

This group of interviewees portrays sustainability as the transition towards green growth, that is to say, the investment in clean technologies and the involvement of the private sector as a key partner of government in the modernisation of productive activities. Informal actors pose a threat to this agenda, because they have, historically, tended to resist the modernisation of urban environmental management in the city. Thus, the solution is either to convince them to formalise and join the investment efforts, or to curb their power by tackling corruption. In both cases, they are a barrier rather than a force in the sustainability transition - their potential role as holders of experiential knowledge is never discussed within this discourse.

On the other hand, interviewees associated with the "resilient" vision of informality suggest different policy pathways, more organic and less planned. In this vision, what is important is to identify what works well in the city (that is, in a sustainable way) and learn how it can be promoted and encouraged. Some successful practices may be identified within informal contexts. By breaking the law, informal actors contribute to making society work, in the face of state failure. If working informally is necessary to provide one with a job, a house and basic services, then informal actors are participating in the construction of the city and to citizens' quality of life (by providing urban services); in this sense informality is the key to urban sustainability, because it is a system that is resilient by its flexibility and by its efficient use of resources. In this view, urban sustainability strategies should learn from informal processes, and if the laws do not fit the processes, the laws should be changed (as argued by Fed1, see quote on p.134). Interviewees who propose this type of sustainability pathways tend to have a more progressive view of informality as well; besides, they attach more importance to local actors' experiential knowledge than to technological innovation. One institutional representative criticises governmental policy towards small-scale (informal) peri-urban farmers: the policy consists of making them invest in greenhouses in order to expand their output and thus their income opportunities. This, according to the interviewee, is problematic, because these are expensive investments required for the farmers (particularly for those who engage in farming as a subsistence activity, or a secondary activity). Rather, it may be more appropriate to encourage more sustainable production techniques for self-consumption. Taking into account the particular social context is essential to design policies that will be successful, and in order to do so, the farmers have to be considered as "agents of change" (that is to say, engaged in thinking about solutions) rather than the mere recipients of policies and subsidies (Inst 2).

Development, modernisation and racism. Now that the discourses have been described in depth, I want to ask the question of its political role: can the portrayal of informality as illegal and incompatible with the sustainability transition, be a way for civil servants to actively justify and promote a particular sustainability pathway that they deem more favourable?

In this section, I draw on the argument developed by Castellanos Guerrero et al. (2009) in their exploration of racist discourse in Mexico. They argue that racism against indigenous people in Mexico has been used as a "form of ideological domination", a source of political power. Their work analyses the construction of the Mexican nation, and the need to tame rebellious groups who threatened the vision of a modern, unified Mexico. As these groups tended to be indigenous, racism has been used to deny the legitimacy of their political stands. This racism expressed itself in a particular way, which according to the authors, was the manichean

opposition of what is “indian” to what is “civilised”. In the rhetoric of the dominant class, the indigenous culture was associated with barbarism and savagery and in opposition to “civilisation”. Yet, the authors argue, in contemporary Mexico, the racist discursive model is still used to render indigenous groups more “governable” in particular when their actions go against the interests of the state: “ [Racism is] a mechanism for producing *evidence*, objectifications, transformations of something like “Indian” with a more tangible object for the exercise of power”. For instance, this is done by associating ideas of indigeneity with drug trafficking, savagery, idiocy, and more generally incompatibility with a modern society. In the Mexican context, this mechanism is particularly important in the fight against political indigenous groups, such as the Zapatistas, fighting for autonomy of the indigenous people and a new kind of local participative democracy. As the authors put it:

“The ethnic issue was never a priority issue in the national congress, with the exception of situations in which it was necessary to clear the way for capitalist expansion and to consolidate the Mexican state. [...] Parliamentary discourses do not cease to fix, in the social imaginary, a figure of the indigenous people as an obstacle *to progress.”* (Castellanos Guerrero et al., 2009, p.247)

Thus, the authors conclude, liberalism and the objective of “development at all costs” are the underlying ideologies of racism. One illustration of this racism maybe be found in a story that Loaeza (2004) relates in her essay on the life of maids in Mexico City. In it, an upper class housewife thinks about her lower-class, indigenous maid:

“Pushy servants, all they do is ask for more and more, they’re so annoying and ungrateful. Not in a million years did these Indians ever imagine that they would end up living like civilized people and not like animals in that hick town they come from. Lazy girls, so rude and good for nothing, you give them a hand and they ask for an arm, what else can they possibly want, they have their own room with a TV, three meals a day, hot water, uniforms, and on top of it all they want to be paid like executive secretaries when they can’t even answer the phone properly.” (Loaeza, 2004, p.253)

In this extract as much as in the interviews, referring to lower-class urban poor as “indians” seems to be a way to appeal to an imaginary of savages, non-civilised population, which therefore deserves less than other citizens - this discourse is thus used to legitimise an effective inequality in treatment.

The parallel between this view and the findings from the analysis of my interviews may not, at first, be obvious. One way to make this parallel more obvious is to highlight the fact that, in the Mexican context at least, urban informality is correlated with indigeneity: throughout

the 20th century, migrations from the countryside to the cities were a result of extreme poverty and a hope to find a job in the city. The migrants were the poorest groups of society, and were in many cases, indigenous. In contemporary Mexican cities, the poorest groups, who work in the informal sector, therefore tend to be indigenous groups, whether migrants or from local indigenous groups (Oehmichen, 2010; Velasco, 2007). Thus, the informality discourses described may appear in a new light: the systematic association of informal actors (who are mainly indigenous) with savagery and corruption, and the antithesis of modernity, becomes very resembling of the racist discourse described by Castellanos Guerrero et al. (2009).

As one interviewee puts it: *"I would dare to say that probably, the informal sector is that which most contributes to the urban chaos, or to urban unsustainability in Mexico - without a doubt!"* (Fed4, Februrary 2015). This quote explicitly makes a correlation between informality and chaos and unsustainability; but it does not explain this correlation in detail. In this regard, Cit4's quote (reproduced and discussed on p.134), is particularly informative. The context of this quote is Cit4's job, which is to ensure availability and affordability of primary goods (mainly food) to Mexico City's population. He explains that his strategy is to "modernise" the public food markets, in order to ensure their success (one strategy being, for instance, to encourage stall workers to accept debit and credit cards). Yet, he explains, the implementation of his strategies is faced with resistance - which, to him, is problematic. In this quote, he argues that people who resist his policies think "in a medieval way", they do not have a modern culture. Thus, resistance or mere disagreements with the interviewee's way of thinking is portrayed as being backwards - when the interviewee compares himself and his ideas to the erudition of the French revolution. Here, the discursive exercise of associating informal workers with backwardness aims to legitimise the interviewee's attempt to achieve an objective, value-free state of modernity (as opposed to imposing one of many views of what modernity is). Throughout the interview, this interviewee denies the positive role of informal workers in providing a service to society by selling affordable primary goods. He first explains that the formal markets provides affordable goods (and thus, there is no need for an informal market). Then he emphasises that informal markets sell luxury products (clothes or cosmetics) rather than food. Finally, he associates informal workers with selling arms and drugs, using violence to assert their right, and being involved in corruption. As in one extract:

"The city could be, let's say, like an English one, if someone said: 'no more political arrangements and bribery' - which is what causes so many problems. When I walk from Tepito to go to La Merced [nearby neighbourhood] [...] you see the road... one whole lane is used by their trucks. And then the next lane is full of trash - and there is a municipal truck who picks up their

trash, a truck that we pay for with our own taxes - it's picking up their trash! This is not right. This is not like Mexico City [laughs]. Maybe this happens in India, or in ... Africa, I don't know. But that my taxes have to be used, that the work of these employees, waiting, because these arseholes throw away trash everywhere in the street... this and all the other problems they generate." (Cit4, February 2015).

By associating African countries or India with the problematic impunity of informal workers; and England with the abolition of corruption, the interviewee places Mexico in a linear process of development, to become like England, and do away with the barbaric practices that informal workers have - such as throwing trash in the street. Again, informality appears to be clearly incompatible with a modern, developed state - and within this discourse, any potential positive contribution of informality to urban life or sustainability is denied. Therefore, the legitimacy of informal actors as stakeholders in urban environmental management, or merely as citizens, is denied in this discourse - and as a result, the only logical solution that emerges is eradication.

This thought process described in the case of Cit4, can be observed in the interviews of those civil servants using the "illegality" discourse, characterising informality as the antithesis of modernity and sustainability. The narratives of informality appear to play a role in justifying and reinforcing the interviewees' visions of a desirable society (which, in this case, is that of urban sustainability understood narrowly through the concept of green growth). This, as the following section shows, has a direct impact on how informality is portrayed and dealt with in policy-making.

5.2 The discourses embedded in policy-making - the case of Mexico City's Zero Waste Plan

The previous section has explored discourses of civil servants around informality and its contribution to urban sustainability. In this section, I look at the implications of the green growth discourse on policy-making. I focus on the green growth discourse because it is the most common among Mexico City civil servants who are in charge of the city's waste management policy. I use the case of the *2016-2020 Integral Solid Waste Management Programme for Mexico City* (commonly known as the Zero Waste Plan), which is the main document outlining the city's overall strategy for waste management (and is previously presented in Section 3.2.2). The analysis is based on two distinct documents: the first one is a draft version of the Plan, which was written by consultants (hired by Mexico City's Ministry of Public Works and Urban Services, SOBSE for its Spanish initials) in 2015 and is therefore a technical document. This document

was never made public; I was able to read a copy as part of my fieldwork. The second document is the Plan which was officially published in 2016. In this analysis, I start by exploring key features of the Plan (a focus on technological fixes, and the invisibility of informal waste workers) and relate these features to the green growth discourse; I then discuss the implications for the treatment of informality in the city's waste management policy.

5.2.1 Presentation of the Zero Waste Plan and its design

A focus on technologies particularly strong in the draft version of the Plan. The Plan's main objective is to reduce the amount of domestic waste reaching landfill. To achieve this, it proposes strategies at each stage of the waste management chain (waste generation, separation, collection, transfer, waste recovery, landfilling) - with additional transversal strategies looking at the regulatory framework. Despite this wide-ranging scope, the Plan is heavily focused on the investment in new technologies: a majority of the solutions proposed involve public-private partnerships (PPPs) and investment in technologies for waste recovery, such as waste-to-energy programmes, biogas plants or innovations in composting sites. These solutions are complemented with non-technological policy-tools, such as working towards waste separation in the domestic and private sector, and the re-introduction of construction and industrial waste in productive activities.

The technological focus of the published version of the Plan is actually toned down compared to the draft version. In that draft, the stated objective of the Plan was threefold:

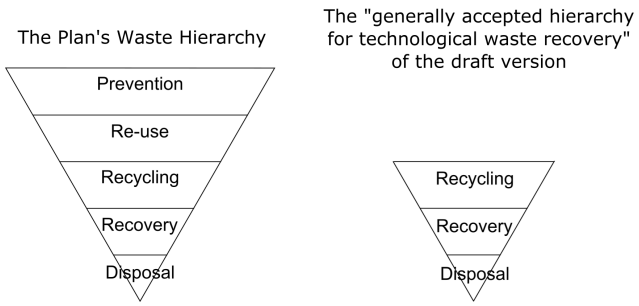
- "a reduction in the proportion of waste sent to landfill",
- "the adoption of technological processes [...] to reduce GHG emissions associated with waste disposal",
- and to "sanitise existing landfills around the city".[2]

The second bullet point mentions the adoption of technological processes as *an objective* of the Plan. As such, the reliance on technology is embedded in the objectives of the Plan, and arguably determines the choice of strategies proposed. Indeed, a whole section of the draft is dedicated to technological innovations that are "necessary" to enhance waste management, and particularly to achieve diversion from landfill. These include bio-digestion, compost plants and waste-to-energy. In this draft version, there is no mention of waste prevention but merely waste recovery through the use of technologies.

[2]This third objective relates to Bordo Poniente, the largest landfill in Latin America (900 hectares) which was Mexico City's main landfill, and closed down in 2012 after reaching maximum capacity. It is yet to be sanitised (the waste is left at the open air and is not being buried or incinerated, and is therefore slowly releasing leachates and methane). The plan aims to recover biogas and work with NGOs and the private sector to sanitise the landfill site.

While the published Plan proposes to act according to the well-known waste hierarchy (reproduced in Figure 5.1), and therefore integrates considerations of waste prevention and re-use in its principles, the draft version is based on an alternative version of that hierarchy, presented as a "generally accepted hierarchy for technological waste recovery" including recycling (for instance, composting), down-cycling (waste-to-energy) and disposal, but excluding the two favoured stages of prevention and re-use of waste. Indeed, the draft version of the Plan does not consider any non-technological options for improving the waste management system.

Figure 5.1: The waste hierarchies as they appear in the final and draft versions of the Zero Waste Plan



Source: Own elaboration

Thus, although the technological focus is not immediately apparent in the published version of the Plan, it was a stated objective of its draft version. The modification of the draft of the Plan is surely the result of negotiations of a range of political actors (within and beyond SOBSE) - these happened behind closed doors and it is fruitless to speculate as to how these negotiations took place. Although it cannot be known *why* the technological focus, so prominent in the draft version, is toned down in the published Plan, looking at the draft version allows to identify the original motivations for producing the Plan - namely, the promotion of investments in technological innovations.

Portrayal of informal actors in the Zero Waste Plan. Although the Plan does mention and describe the governmental infrastructure in detail, informal actors are not explicitly mentioned in the report. Yet, there are two instances where the document could easily mention informal waste-picking. The first is with regard to *pre-pepena*, which is the waste-picking that takes places on the municipal waste collection truck, carried out by municipal employees. As shown in Figure 3.9 (p. 80), the Waste Inventory does include *pre-pepena* in its waste flows diagram - and provides a quantified estimation. Although the Zero Waste Plan is based on that same Waste Inventory, and does reproduce a partial version of the waste flows diagram, the flow resulting from *pre-pepena* has been taken out from the diagram in that reproduction. Therefore, there is

no mention in the Zero Waste Plan (neither in the diagram nor in the text), of the existence of informal waste picking in the city's waste management system.

The second omission concerns the organised groups of informal workers who manage the Waste Selection Plants. In the draft version of the Zero Waste Plan, the following mention was made: "The operation of the waste selection plants consists in putting the waste materials to be separated on a conveyor belt so that *informal waste pickers* can select and recover recyclable materials" (own translation, emphasis added). This inclusion in the draft version provides very little context, as it does not explain who manages the informal waste-pickers, how they are paid, and what their working conditions are like. Still, it acknowledges their existence - acknowledgement that has been taken out in the published version of the document.

Thus, despite evidence that the institution in charge of writing the Plan (SOBSE) has at least partial knowledge of the existence of informal waste-picking on governmental infrastructure (namely the waste selection plant and the municipal waste collection truck), the report does not mention this. The contribution of these actors to recycling (and to the objective of diversion from landfill) remains invisible.

On the other hand, informal actors are mentioned in a very indirect way in a different section of the programme. In the section tackling waste recovery, one of the objectives that is presented is to "establish small recyclables shops ['centros de acopio' in Spanish] for the purchase of inorganic waste with recycling potential, through private-public participation schemes, with companies that recover or export the materials [...] with a modern and functional design" (SEDEMA, 2016, p.25, own translation). This sentence implies that these shops do not yet exist and have to be created - with no regards for the myriad of existing family recycling shops (formal and informal) doing just that. More troubling still, a later section of the Plan proposes the following quantifiable target with regards to recyclable shops:

"From 2017, strengthen the regularisation and formalisation of establishments who trade recyclable materials. For 2020, strengthen public-private and social partnership schemes to incorporate recyclable materials to productive activities, with the aim to consolidate recyclables shops as economically viable options." (SEDEMA, 2016, p.38, own translation)

This is associated to a quantitative indicator measuring "the percentage of establishments who trade recyclable materials which have been regularised and formalised", the target being a one hundred percent formalisation rate of a given 800 establishments. Here, the programme therefore implies that these recyclables businesses already exist in the informal economy - however this claim is never justified (let alone the estimation of 800 establishments throughout the city). There is nothing in the text as to why these establishments need to be formalised and

what that would entail (in terms of training and compliance with environmental regulations for instance).

5.2.2 Waste management and the knowledge production process.

The production of the Zero Waste Plan as furthering SOBSE's objectives. One way to try to explain the apparent biases of the Zero Waste Plan is to explore the process through which it was designed. One crucial aspect of this is who produced it, and for what purpose. One interviewee who participated in writing the Plan explains that the Plan was produced with a specific objective in mind, namely: "to solve the problem of the SOBSE: dispose of the waste produced in a cheaper way" (Cit5, Feb. 2016). It appears, from this quote, that the whole process, from the production of data (that is to say, the waste inventory) and the generation of strategies is subjected to this objective. Looking at the latter (the generation of strategies), the interviewee explains:

"this [a holistic waste management strategy] is not happening, because the Plan is not being designed by the governor. It is designed by SOBSE, to solve SOBSE's problems. The plan should have been produced by the governor, in collaboration with the Ministry of the Environment and the Ministry of Urban Services. However, there was no vision, and no budget – this is why this hasn't happened." (Cit5, Feb. 2016)

With regard to waste, SOBSE is only in charge of finding and paying for disposal sites. Indeed, this is reflected in the main objective presented in the Plan, which is to reduce the amount of waste reaching landfills. The strategies proposed (waste-to-energy, increased composting) aim to reduce the Ministry's spending on paying for private landfill sites; and will provide opportunities for infrastructure projects (for instance, public-private partnerships for the composting sites and bio-digesters). In that same interview, I asked about the possibility of other waste management strategies, such as waste prevention (for instance, prohibiting the sale of water bottles in the city) and recycling (enhancing separation and recycling practices in the city). And I was answered that these policies are of no interest to SOBSE: what SOBSE is interested in, is building infrastructure.[3] There are two reasons for this: the first, mentioned explicitly, is that SOBSE's purpose is to build infrastructure: it has the budget, technical capacity and institutional prerogative to do so. It therefore makes more sense to achieve diversion from landfill through building infrastructure, than, for instance, through waste prevention strategies (which may be as efficient but which SOBSE would not have the capacity to implement). The second reason is the potential personal interests of civil servants. The interviewee mentions different cases of corruption in SOBSE, where the main interest of particular civil servants was

[3] Interestingly, these strategies were later included and are mentioned in the published version of the Plan.

to push through particular infrastructure projects, which can be traced back to their personal financial interests. In those cases, the waste inventory was instrumental in legitimising those investments in infrastructure as contributing to enhancing the waste management system.

The way that the Plan is produced therefore explains its focus on technological solutions: SOBSE, being the sole agent in charge of implementing these strategies, chooses strategies which help achieve its objectives as an institution, those which it can implement (based on its prerogatives, capacities and budget); and in some extreme cases, also those which serve civil servants' personal interests.

The data production process. This process of policy-making does not only affect the way strategies are made, but also the production of data itself. Again, this is explained by the interviewee, who deplores that rather than investing in a periodic, independent data creation process, each government department builds their own dataset as and when they need them to work on a particular project or strategy. In the case of the Zero Waste Plan, the database (the Waste Inventory) is produced solely for the purpose of the Plan - designed by SOBSE, and will not be used in the future, or by other government department. Thus, SOBSE is free to design the waste inventory as is most useful in order to achieve its objectives. SOBSE's waste inventory is extremely similar to the one presented in the case study context chapter: it is a quantitative waste flows diagram, focusing only on flows through the government infrastructure. This focus on governmental, quantitative data, according to the interviewee, is aimed at enabling specifically the production of the 2016 Zero Waste Plan. As such, it provides a particular approach to the representation of data: the quantitative aspect of the diagram makes it easy to show how much waste will be diverted from landfill with the new strategies. The focus on governmental flows reflects a concern in representing only those waste flows which can be controlled by SOBSE. The other flows (through the private sector or the informal economy), the interviewee explains, are of no interest within this Plan - as it cannot help to design a strategy that SOBSE can implement - and are thus absent from the new inventory (Cit 5, Feb. 2016).

Where does informality sit within this understanding? The argument presented is therefore, at first sight, one of efficiency: SOBSE is building a dataset that is specifically designed to produce the best strategy possible, that will easily be implemented. In this perspective, it is easy to justify the exclusion of informal waste-handling from the waste inventory: as these activities cannot be controlled by SOBSE, or improved through a strategy, there is no point investing in even generating the data. As the interviewee puts it: "We include the parts of the informal waste-picking that we more or less know of, but we do not make an effort to know more, because this will not result in any strategy" (Cit 5, Nov. 2015).

I asked the interviewee why the Plan did not propose a recycling strategy, perhaps involving a PPP (as it does with composting and waste-to-energy). This was his answer: "No, it's important not to touch recycling, because it already works through a virtuous cycle [namely, informal waste-picking]. It's better not to touch anything. [...] Mexico City has the most efficient recycling system in the world!" (Cit 5, Nov. 2015).

What the interviewee expresses is the idea that because informal recycling works well on its own, SOBSE's efforts would be best focused on areas which do not currently work so well (composting, and waste-to-energy programmes). Again, this argument of efficiency holds: there is no point in producing data on informal waste handling, because it works well, and government involvement would likely not improve its operation.

Yet, efficiency is not the only factor to consider when assessing the quality of the dataset produced. As much as the waste inventory focuses on areas which SOBSE can improve, and makes visible how much waste will be diverted from landfill with the new strategies proposed by SOBSE, it might at the same time obscure other important aspects of waste management. Let us take the example of waste handlers' working conditions within the informal economy. This aspect of waste management is doubly excluded from the waste inventory: the focus on quantification of material flows excludes social concerns, particularly those regarding workers' health and well-being; and the focus on governmental flows excludes those who work outside of this framework: that is, the informal waste handlers.

I prompted the interviewee about this topic; and his answers proved that he is aware of health concerns for informal workers. He mentions two examples (which incidentally address the two mentions of informality in the waste inventory, indicated above). The first one relates to the *pepenadores*, or informal-waste pickers, who perform waste-picking on the municipal truck (the "pre-pepena"):

"It is known that on average in Mexico City, a pepenador has an accident every month. An example of an accident would be to have their hands being eaten by the machinery in the truck, resulting in amputation. But these people have no paperwork, they are not employees of the city." (Cit5, Nov. 2015)

The second example refers to the informal waste-pickers who work in the (government-owned) waste selection plants:

"In Santa Catarina, the land is own by the leader. The government built the plant, but it has not entered the premises since the construction ended. It's a problem, because nobody knows what goes on in there... How much waste is separated, how much is recycled? How are the workers treated? We know there is a communal pit [grave] in there... How many people die on

the plant? [...] It is problematic, because it means that somehow, the government is supporting illegality, and is tolerating a sort of slavery." (Cit5, Nov. 2015)

These extracts clearly show that the experts in charge of designing the Plan were aware of those issues. Excluding informal recycling from the waste inventory thus becomes a conscious act, as shedding light on these issues would be admitting, in the interviewee's own words, that the government is "tolerating slavery" - hence endangering the durability/permanence of the "virtuous cycle".

Rather than merely resulting from a concern for efficiency, I thus argue that the data production process forms part of the political construction of a particular discourse with regard to informality and its role in urban environmental management.

5.2.3 Relating the case of the Zero Waste Plan to the green growth discourse

The discourse of green growth presented in the first section of this chapter appears to be underpinning not only civil servants' assumptions and mental constructions, but also to have a direct impact on policy-making. Looking at the construction of the Plan, one can observe the promotion of technologies as the main pathway towards sustainable development. This is achieved, in part, through the design of the main dataset (the waste inventory) which is actively built to justify and legitimise technological solutions to waste management.

Looking at waste management in a holistic way (that is to say, using the most exhaustive data possible) would potentially put forward innovative solutions to the problem (including those found in the informal sector). In contrast, by using an incomplete waste diagram, policies and solutions are restrained to strategies related to the waste flows which appear on the diagram. Thus, the content and presentation of the waste inventory structure the waste strategies that can be designed: the diagnostic legitimises particular strategies (the investment in technological innovations), as well as the absence of alternative strategies (addressing informal recycling).

Indeed, informal actors' role is made invisible in the waste inventory (despite being acknowledged by civil servants). This exclusion has two main consequences: firstly, this hinders building on the existing strengths of the informal sector, and finding solutions which may be cheap and using local knowledge and labour. Secondly, it hides the problem of the working conditions of informal workers (and the fact that the government knowingly benefits from this system and ignores these terrible working conditions).

Thus, the Zero Waste Plan appears as one of the devices through which the government is building authority over waste, and particularly through a particular discourse which portrays informal actors as irrelevant and illegitimate in the management of urban waste. By doing this,

civil servants can legitimise their focus on technologically-heavy policy options - which is both easier to do institutionally and in some cases, more lucrative personally.

5.3 Waste collection in Tepito - the impacts of these discourses on the ground

Section 5.2 demonstrated that the discourse which dismisses the role of the informal economy, shapes the policy process and contributes to building authority over waste. In this section, I turn to the impacts of this discourse on the everyday provision of urban services. I argue that the way informality is systematically denigrated in the policy process affects the relationship of civil servants and those citizens who feel targeted by the discourse - the lower class, indigenous, informal urban poor. This has, over time, created a relationship characterised by mistrust, antagonism and violence, which affects many aspects of urban governance.

I take the example of the waste collection service in the neighbourhood of Tepito, in the Cuauhtemoc municipality. Tepito is an interesting case because of its relation to urban informality: it is a place where most people's livelihood depends on informal activities and where a range of services are provided informally. Most residents would proudly identify with informal practices. In addition, most of Tepito's residents fit the portrayal of informal actors used in the dominant discourse: they are not only citizens who earn a living in the informal economy, but they also form part of the lower economic class of the city. Most of them are migrants from the rural areas of Mexico, and are thus ethnically and culturally indigenous (for more background on Tepito, see Section 3.4). Thus, Tepito is a neighbourhood which reflects the informality portrayed in civil servants' discourse.

I take two examples to show how Tepito's municipal waste collection service is affected by the discourse which dismisses informal workers. First, I explore how this discourse impacts the allocation of governmental resources, and therefore the quality of waste collection service that is provided in Tepito. Secondly, I present insights of how this discourse has, over time, permeated in everyday social relationships in the neighbourhood, and has contributed to a long term relation of mistrust, antagonism and violence between civil servants and Tepito residents.

5.3.1 The distribution of municipal resources - the case of the waste collection trucks

In 2015, the mayor of the Cuauhtemoc municipality acquired seventeen new waste collection trucks, in order to address weaknesses of the waste collection service throughout the municipality. Eleven of these new trucks were to replace old trucks on existing routes, while the remaining six were to be used on new routes, designed to attend particular neighbourhoods where

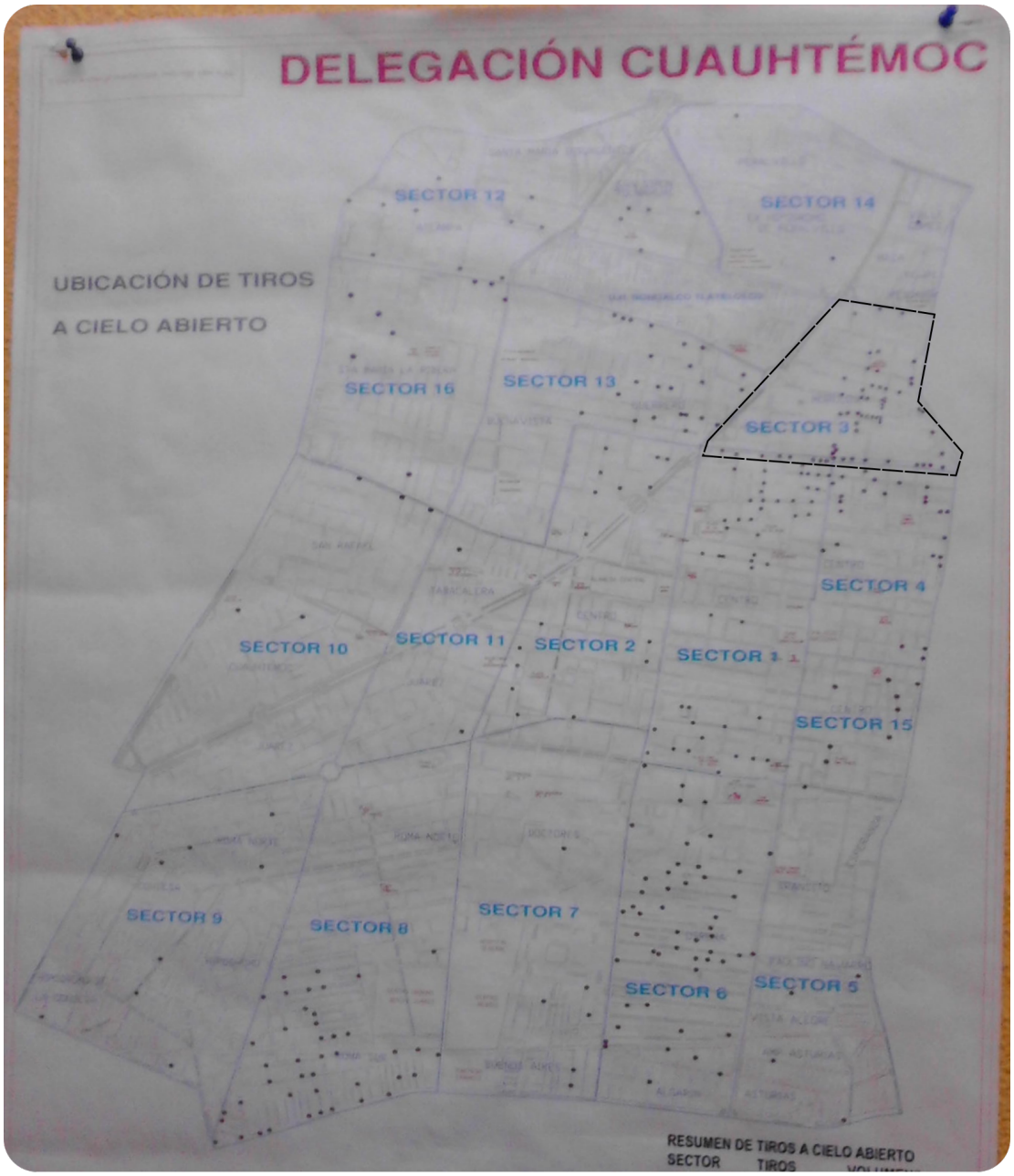
they were most needed. The Department of Urban Services (the entity within the Cuauhtemoc municipality responsible for waste collection) was in charge of the allocation of the trucks.

The civil servants' story. In February 2016, civil servants within the Department of Urban Services were getting ready to make a decision as to how the six new trucks and routes were to be allocated (on the other hand, the eleven trucks would merely replace the oldest trucks in the municipality, meaning that the allocation was already decided). This is when I conducted an interview with one member of the team - within which, among other topics, the allocation of the trucks was discussed (interview 55, February 2016). The team would determine the allocation by looking at the situation on the ground: the criterion was to identify the areas of the municipality with the weakest waste collection service - therefore, the ones which most needed an additional route. In order to identify these areas, the Department produced a map of clandestine waste dumps - a recurrent problem throughout Mexico City: piles of trash, dumped by local residents, accumulate on street corners. The reasoning is that illegal waste dumps indicate a poor waste collection service (citizens have to resort to dumping waste on the street when the collection service is poor or non-existent); which means there is a lack of trucks and routes, and thus justifies organising new routes there (Mun9, Feb. 2016). Thus, the neighbourhood with most clandestine waste dumps would get allocated a truck, and the associated new route.

The map of clandestine waste dumps, essential to the allocation process, was built based on observations on the ground, and with the help of local sector managers. A large printed version of this map, including a quantified table, is pinned on the wall of one of the Urban Services offices; I was invited to look at it and to take a picture of it.

Figure 5.2 is a reproduction of that map, to which I added a legend and the borders of Tepito. The quantified table which was part of the original map is reproduced in Table 5.3. Both the table and the map show a high variation of the number of dumping sites observed in different neighbourhoods, ranging from a mere two in Sector 11, to over fifty in Sectors 1, 3 and 6 (which include the historic city centre, Tepito, and another low-income residential neighbourhood called *Obrera*). Indeed, those differences identified in the map and associated table (in bold), prove a useful indicator as to which neighbourhoods may require additional resources to improve the quality of the waste collection service. Particularly, the Sectors 1, 3 and 6 (and Sector 8 to a lesser extent) appear to have the most clandestine waste, both in terms of number of dumps and their volume - they therefore would be most likely to get the new routes. Yet, the garbage-men, working on the ground, have a different story to tell.

Figure 5.2: Map of illegal waste dumping sites, Cuauhtemoc Municipality, 2016



Legend:

- Observed illegal dumping sites
- Tepito

Source: Picture taken at the Cuauhtemoc municipality offices in 2016, overlayed with the borders of Tepito and a legend (author's own addition)

Table 5.3: Quantification of illegal dumping sites, Cuauhtemoc municipality, 2016

Sector	Dumping sites	Volume (kg)
1	**55**	**26,150**
2	16	5,000
3 (Tepito)	**52**	**48,600**
4	24	12,200
5	5	1,300
6	**50**	**15,000**
7	6	1,250
8	43	13,400
9	9	2,300
10	5	1,600
11	2	700
12	15	6,250
13	23	7,400
14	3	600
15	8	1,600
16	8	2,250

Source: Data from Cuauhtemoc municipality, 2016

The garbage-men's story. Around the same time that I conducted the interview in the Department of Urban Services, I was in Tepito conducting fieldwork, interviewing and observing the work of the garbage-men. With them as with the civil servants, the topic of the allocation of the trucks came up.

"Wh13: We have heard rumours that there will be eleven new trucks for all the municipality. Ask me how many of those eleven trucks will arrive here, to this sector.

Interviewer: How many?

Wh13: None. Supposedly, the authority, well, they've just arrived [in power], maybe they don't know much about the [waste collection] service, but they take a risk, they try to see where those trucks are really needed. To improve the service, they will not send them where they already have good trucks, or where they have more trucks [than elsewhere]... Well, this would be a logical decision. But I tell you, out of those eleven that supposedly will arrive, not one, not one, will get here.

Interviewer: So how will they decide where to send them?

Wh13: This is what we are asking ourselves too.

Wh14: They go to the best bidder: that is to say, there are truck drivers with those routes in the good neighbourhoods, they do well; so they go to the person in charge of distributing the truck and they say "there you go, this is for you. Here are five thousand pesos, ten thousand pesos for you, give me a new truck. So they are already set aside, they have all the control

over there, and they forget about here - because here, well there's nothing. Only trash. In other neighbourhoods, they are given [tips] - they get extra money, they have more flows of cash, so it suits them to have a new truck because they can get even more money out of it. And here no, there's only trash. Here there isn't anything." (Interview 31, Wh13 and WH14, Oct. 2015)

In a later conversation, different workers had a different perspective:

"Wh24: The thing with the trucks is about social class: the best trucks go to the best neighbourhoods... It's just that here we use huaraches*! [traditional Mexican sandals, T.N.] [Laughs] We are dark-skinned...*

Interviewer: Why is that?... that you don't get the truck?

Wh23: Who knows!

Wh24: They don't like us... And it's wrong, because there is more trash here. If you compare with Condesa [an upper class neighbourhood located in Sector 9]... there is more density here, and because of the street markets, we generate three times what they generate there! But they have all the good trucks, because the government wants to make a good impression on those who have money. This is wrong. Can you imagine, in Condesa, they don't even go to the municipal transfer centre every day, because the trucks aren't full! On the contrary here, we have to go twice, even though they give us the same amount of gasoline...". (Interview 50b, Wh23, Wh24, Jan. 2016)

Although the two explanations are different, they depart from the same argument: in order to ensure a fair and objective allocation of the trucks, the civil servants should identify the areas with the least resources, and where the trucks are most needed. As Wh24 explains, following this process, Tepito ought to get a truck, as it is a sector with more waste to collect - and less trucks - than other sectors (such as Sector 9). Indeed, this perspective fits the decision-making process described by the civil servant, insofar that the trucks should go to the areas that most need it - and that one of those areas is Tepito (according to the civil servants' quantification, Tepito is one of the three sectors with the worst service, as shown in Table 5.3). Yet, both groups of garbage-men predicted that Tepito would not be allocated a new route. They offered two different perspectives which both provide a possible explanation as to what happened.

In Interview 31, the argument put forward is that of corruption. Wh14 explained that the trucks go to the "best bidder", that is to say, that different sector managers bribe those in charge of making the decision, in order to be allocated a truck. According to the interviewee, garbage-men who work in richer neighbourhoods tend to get more tips from citizens - by saving this money, they can use it for bribery. In Tepito, which is a poor neighbourhood, no money can be made from tips - therefore, civil servants do not consider it lucrative to send a new truck there.

This reflects a general feeling of Tepito's garbage-men: they feel that they are abandoned by their hierarchy because it is well known that no money can be extracted from waste management in Tepito. As the team does not collect tips and can collect only limited amounts of recyclables,[4] then there is no point in investing in the neighbourhood.

The second group of interviewees rather emphasised class-based racism as the reason for an unfair allocation of resources. Wh24 explained that "the best trucks go to the best neighbourhoods"; and in order to illustrate why Tepito is not one of those "best", he stated that in Tepito, people wear *huaraches*. Wearing the traditional Mexican sandal is a sign of being indigenous; as is being "dark-skinned". These comments thus arguably refer to the racism perceived by indigenous groups on the part of Mexican institutions. Being indigenous is associated with being a citizen of second-class - expressed by Wh24 as "they don't like us". Wh24 is expressing his awareness that because Tepito is a neighbourhood that is predominantly indigenous and low-income, they are considered as second-class citizens by governmental authorities, and this is why they receive less resources than other neighbourhoods.

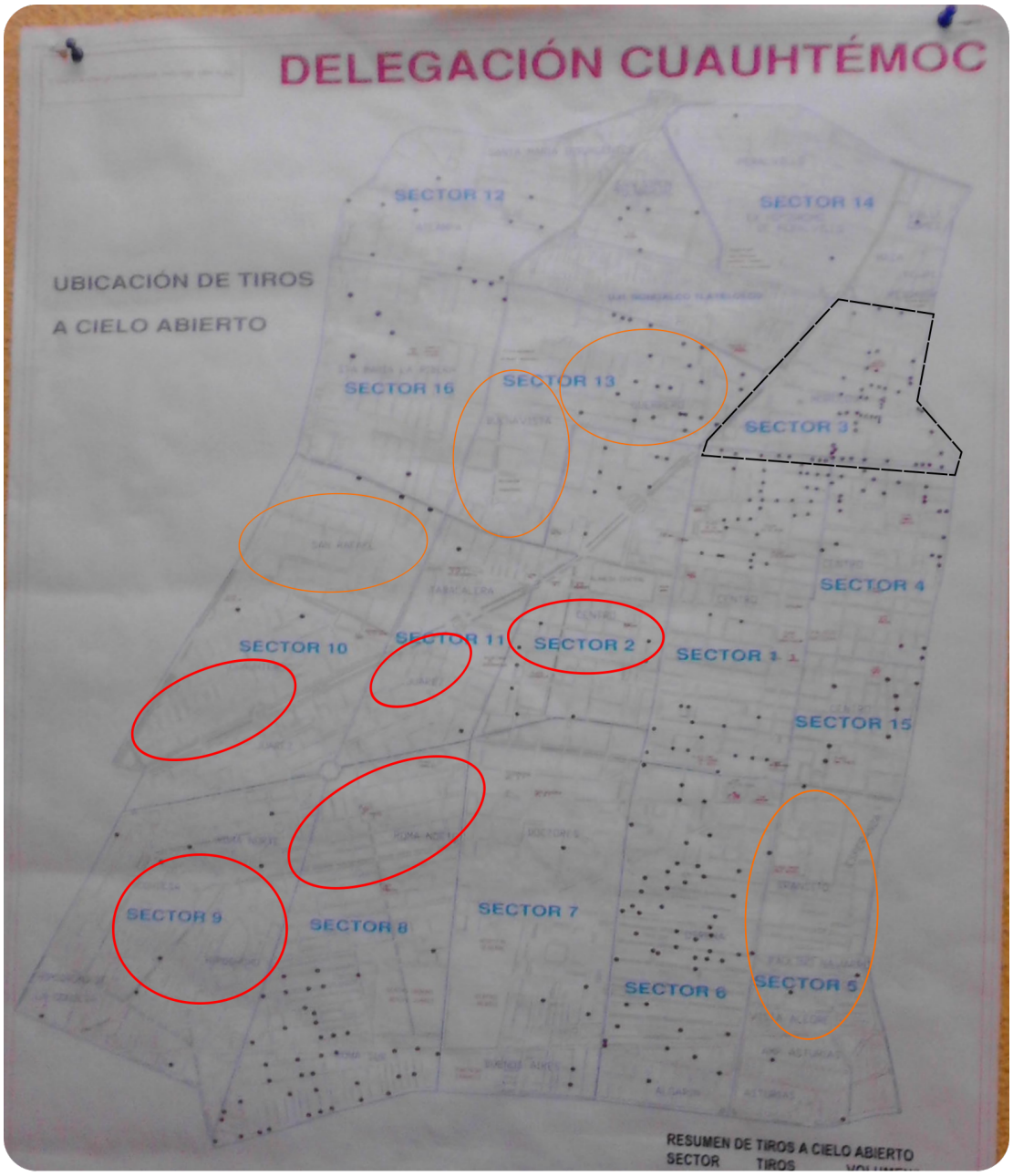
Where were the routes eventually allocated? A few months after these interviews, the allocation of the new routes was announced in the newspaper.[5] As the garbage-men had predicted, none of the new routes were allocated to Tepito. In Figure 5.3, I have overlaid the location of the new routes (main routes carried out daily by the trucks and "secondary routes", that is to say the neighbourhoods where they might provide a collection service as a support team, on an "as-and-when" basis) onto the original map of clandestine waste dumps produced and used by the Department for Urban Services. The superposition of these different layers shows that there is no correlation between the density of illegal dumping sites and the new routes proposed. Indeed, overlaying the new routes on the quantitative data (see Table 5.4) presents similar results: the new routes (in red) will operate in sectors where the observed volume of illegal dumps represents between 700 and 13,400 kg. The sector with the most dumps (Sectors 1, 3 and 6, in bold in the table) are not covered by the new routes. Tepito (Sector 3) is the sector with the biggest volume of clandestine dumps (with 48,600 kilos) and will not receive a new route.

In addition, none of the eleven trucks which were substituting the older trucks arrived in Tepito (which is serviced with at least one truck from 1980 (Wh13, Oct. 2015) and another from 1972 (survey n.34, January 2016)).

[4] Waste picking on the municipal truck is another way to make extra money, through the sale of recyclables in the informal market. In Tepito, this practice is not widespread, as described in Section 6.2.2.

[5] See The Excelsior of 14th April 2016, accessed online on 17th October 2016: `http://www.excelsior.com.mx/dinero/2016/04/14/1086568`

Figure 5.3: Location of new routes, superimposed onto map of illegal waste dumping sites, Cuauhtemoc Municipality, 2016



Source: Picture taken at the Cuauhtemoc municipality offices in 2016 [the basemap]; drawings are author's own additions based on data published in the newspaper The Excelsior.

Table 5.4: Quantification of illegal dumping sites, and allocation of the new routes identified in red

Sector	Dumping sites	Volume (kg)
1	**55**	**26,150**
2	**16**	**5,000**
3 (Tepito)	**52**	**48,600**
4	24	12,200
5	5	1,300
6	**50**	**15,000**
7	6	1,250
8	**43**	**13,400**
9	**9**	**2,300**
10	**5**	**1,600**
11	**2**	**700**
12	15	6,250
13	23	7,400
14	3	600
15	8	1,600
16	8	2,250

Source: Data from Cuauhtemoc municipality, 2016 - identification of Tepito and new routes are author's addition.

Although this analysis clearly shows that the "objective method" presented to me by the civil servant in Interview 55 was overridden, it is impossible to assert with complete certainty which factors were determinant in the allocation of the new routes. Perhaps corruption played a role, as Wh14 suggested. Perhaps, as Wh24 argues, the decision was informed (even if it was in a subconscious manner) by the discourse which systematically denigrates the indigenous, informal urban poor - effectively rendering them second-class citizens. Indeed, this would not be inconsistent with the portrayals of informality presented in Section 5.1, nor the political uses that have been made of class-based racism in order to assert power (as described by Castellanos Guerrero et al. (2009) in that same section).

But perhaps what reflects the impact of civil servants' discourse (of informality as incompatible with modernity) in this story, is not so much the ultimate decision as to the allocation of the trucks; but rather the analysis put forward by the garbage-men in relation to the decision. In the interviews, various garbage-men explain how they have grown disillusioned about their relationship with the civil servants working in the municipality's office, that they do not expect to be treated in a fair way, because of the neighbourhood in which they work. Whether or not racism played a part in the allocation of the trucks, it does, without a doubt, play a role in the everyday work of the garbage-men, and in particular in shaping the power relations between themselves and the civil servants. The fact that this class-based racism is internalised

by the indigenous urban poor themselves is an illustration of its power (as has been argued by Castellanos Guerrero et al. (2009)).

5.3.2 Collecting waste in the markets' streets: waste as an object of conflict.

The second story aims to reflect, from a different perspective, how relationships between citizens and civil servants have deteriorated due to class-based racism. This is the story of everyday waste collection. In this story, the role of the garbage-men is reversed. In the previous story, the garbage-men explain why Tepito is being treated unfairly by the municipal government. Because they work in Tepito every day, and suffer along with the local residents from the lack of resources, they identify themselves with the local residents. In this section, I look at the relationship between Tepito residents and the garbage-men. Here, the garbage-men identify themselves as outsiders. They are municipal employees, and generally are not locals. In the eyes of the local residents, they are (along with the police) the representation of the state in the neighbourhood - thus, they are associated with those who produce the dominant discourse, and those who allocate the resources unfairly. The garbage-men are conscious of this, and explain how this is the basis of their antagonistic relationship with the locals.

A constraint that the garbage-men face in their everyday work is that they work alongside the informal markets' workers. This is first, a physical constraint: the market workers set up their stalls on the streets at around 7:30 am, hindering access for the trucks. This means that the waste workers, who start working at 6 am, have to finish collecting waste by 7:30 am at the latest in the commercial area of Tepito (and later for residential areas). Yet, this constraint is not only a physical one - it is also one that is exacerbated by the conflictive relationship between Tepito's residents and governmental institutions. As the manager explains:

"[With regards to Trabajo Avenue...] it is extremely important that it is left clean since early in the morning, because of the street markets - people arrive and if we arrive after them - well let's say that if it takes us more than half an hour, an hour, well then the street vendors take the trash and dump it in the middle of the avenue! So we have to move it fast." (Wh13, Oct. 2015)

When the interviewee told this story, I could perceive different feelings in his voice and expression; but the most obvious one was resentment. Over the time I spent with the municipal waste handlers, this impression of mine was recurrent, when the municipal workers talked about Tepito's residents and workers. One recurrent expression on the part of municipal employees was: "we don't want any trouble", which expresses their perception of a long-term conflict and the effect it has on their work. As another interviewee explains:

The problem is not with regard to our job, it is with regard to the citizens. We do our jobs, but it is difficult with people from here... They throw trash in the street, and if we tell them something, we get into trouble". (Wh21, Jan. 2016)

One truck driver explains his struggle with people not separating their waste - as they should:

What is necessary, is to educate people. Sometimes we tell them, they need to separate, and they take their gun out! They tell us: "but you get paid to do it!"... they yell at us, they hit us... It's a real problem the relation with the residents here". (Survey 34)

The gun story might be an extreme case, but most municipal employees have a story to tell about being intimidated, or having a violent exchange with a Tepito resident. Another example illustrates the difficult communication between the workers and the residents:

Look, they come here [in front of the warehouse] and even if we're here, they don't even ask for permission or anything, they just throw [trash] on the ground. We would like to tell them to throw it in the truck, but we can't say anything because we don't want any trouble... it's just that people around here... how can I say...? they are very conflictive. (Wh22, Jan. 2016)

Indeed, my own observations on the ground bear witness to this conflictive relationship. As part of a site visit (interview 15, Feb. 2015), I drove around the neighbourhood with two interviewees from the Department of Urban services - the car was clearly identified as a governmental one. In various instances, we would stop the car by clandestine dumps, having a chat. Citizens would come by with their garbage, and dump it on the floor (rather than in the truck stationed next to it). Two of them looked at us, and then spat on the floor. Indeed, walking around Tepito with civil servants, I could perceive a contempt and a violence on the part of citizens, that I never felt when walking on my own.

Garbage-men relate stories of physical fights with the residents over them throwing trash on the ground, and not respecting the rules. Yet, most of them have grown tired of it after some years, and they have their manager telling them "not to get into trouble" so in the end they tend to avoid interactions with the residents. Some employees decided to change their work hours to avoid interaction altogether:

Here in Tepito, the work is difficult because you come to fight with the depraved, the crooks, the delinquents... sometimes they even hit us. You have to know how to handle those people. The problem is very different as soon as you cross the avenue - it's only like this in Tepito. That is why I start working at 3 am to be left alone, to not cross anyone's way, to not have anyone bother me. My shift is from 6 am till 2 pm, but I prefer to start at 3. [...] I work in the heart of Tepito, so I have to be wary of everyone". (Wh23, Jan. 2016)

All these stories show a relation between citizens and civil servants that is characterised by antagonism, intimidation and violence. What this shows is that the local residents have - similarly to the garbage-men in the previous story - internalised the dominant discourse, that informal citizens are second-class citizens. Yet, they have reacted to it in a different way: they fight back. This antagonism to the civil servants who are providing a public service can be explained by this refusal to be treated as second-class citizens. This state of mind has implications in terms of how waste is collected: firstly, citizens do not separate their waste as required by law, and then tend to dump it on the ground rather than handing it to the municipal team - which makes waste collection difficult. More importantly, the garbage-men act as a buffer between angry citizens and disdainful civil servants; this affects, in the long-term, their well-being at work and how they are able to provide the waste collection service.

5.4 Conclusions

This chapter uncovered discourses and narratives that are constructed by decision makers in relation to urban informality and sustainability. It shows that, when asked about the informal economy of Mexico City, civil servants present a rich and diverse understanding of the topic. Their portrayal of informality is not fixed - it evolves and is enriched by experience (as the reliance on personal anecdotes shows). In addition, different aspects of their vision of informality are mobilised when discussing other issues. Informality appears to be intricately linked to interviewees' vision of a modern, developed and sustainable society. At the Mexico City level (where civil servants are in charge of the operation of the waste management infrastructure), civil servants tend to produce a discourse of green growth as a pathway to urban sustainability. The informal economy is portrayed as incompatible with such a vision. In this discourse, informality has to be eradicated if modernisation and sustainable development are to be brought forward.

The dominance of this discourse has implications on the ground which are important to uncover. The example of the Zero Waste Plan shows how this discourse excludes informal actors from decision-making by making them and their role in urban environmental management invisible. Thus, by using this discourse, civil servants produce a particular conceptualisation of informality, which allows them to build authority and legitimacy over waste and to legitimise particular policy options (oriented at investments in technology and PPPs). On the ground, this discourse permeates the relationship between civil servants and those citizens who feel targeted by the discourse - this makes the provision of urban services difficult: policemen, electricity providers, and street sweepers face the same difficulties as the garbage-men.

Beyond its impacts in policy-making and on the ground, this dominant discourse is problematic because it is unclear how well it reflects reality. Indeed, the existence of informal waste handlers and their participation in Mexico City's waste management is obvious to any observant citizen: informal waste handlers work every day in the street (for instance, on the collection trucks and in recycling shops), and merely comparing this reality with the one presented in the waste inventory presents a big discrepancy, and in effect challenges the modernist discourse. Thus, the following chapters focus on empirical research undertaken in Tepito which aims to contrast the view presented in these discourses and present an alternative perspective on the role of informal actors in urban waste management.

Vignettes: Selected stories of waste flows through Tepito

These vignettes present selected stories of waste flows through Tepito - they serve as an introduction to the empirical chapters, and aim to give a sense of continuity to the story. In order to illustrate the diversity of recyclable waste flows, this section includes three vignettes of everyday objects, and their management from the moment they are discarded as waste: a cardboard box, a soft drink plastics bottle and an aluminium soft drink tin can. These vignettes show that because they are made of different materials (cardboard, plastic, metal), these three objects will be handled by different actors, and will follow different routes towards recycling - with a diversity of spatial and temporal scales. These vignettes zoom in on different waste handlers, focusing on their everyday activities. The following chapters of this thesis provide a better sense of the role of these actors in the neighbourhood's waste management system.

Vignette 1: Flows of cardboard

Let us follow a piece of cardboard from the moment it is discarded as waste in the streets of Tepito, until it is re-used as an input in a productive process. In the street of Peralvillo, in the western part of Tepito, there is a shop which sells blank disks, to be used to make DVDs of pirated movies. These blank disks arrive daily in cardboard boxes. When disks are bought, they are transported in these boxes to a local factory where the pirated movies are made. Then, the newly-made DVDs are bought by a market worker, who transports them to his stall in the street of Fray Bartolomé de Las Casas, the street specialising in pirated movies and music. There, he unloads the DVDs, arranges them in his street stalls, flattens the cardboard box and stores it on the side of his stall. Around 7 pm when the trading hours are over, he stores the unsold DVDs into plastic boxes, which he puts on a trolley and goes to store in one of the warehouses of the neighbourhood. He then cleans his stall and leaves the waste produced during that day (a Styrofoam box from lunch, a soft drink plastic bottle, some damaged DVDs, and the cardboard box) right beside the stall. He then leaves and goes home. About an hour later, the street

sweepers arrive, and by using their brooms, push all the waste towards the end of the market street. The accumulated waste spends the night on the side walk of Eje 1, the street which delimits the southern border of Tepito. At 6 am on the next day, the municipal collection truck comes, and municipal workers use shovels and brooms to move the waste into the collection truck. There is an informal waste picker working with them: a workers' brother is unemployed, and the team allows him to jump on the collection truck and work with them for the day. His role is that of a "voluntary helper", a term commonly used to described these unwaged workers working alongside the municipal teams. His task is to help out with waste collection; but additionally he is allowed to separate valuable materials from the waste being collected. That is to say, instead of merely depositing the waste into the truck, he spends his time separating the cardboard, plastic bottles, and stores them on the top of the collection truck (see Figure 5.4).

After the team finishes its collection route in Tepito, the workers and the helpers come off the truck and go perform another task for the day, such as sweeping the streets of the neighbourhood. The driver drives the truck toward the municipal waste transfer centre, located on the other side of the Cuauhtemoc municipality, six kilometres away, where he is to deposit the waste collected on the route. Yet, he will do one stop before that, in the street of Aluminio, right outside Tepito: there, he will go to a recycling traders' warehouse, and sell the recyclable materials gathered by the voluntary helper, and stored on the top of the truck. Part of the money he makes from this transaction will be used to pay the voluntary helper for his days' work.

In the warehouse, the cardboard is cleaned and compacted, to make a cardboard bale (see Figure 7.5, p.216). It can take a few days for the recycling shop to gather enough cardboard to make such a bale (which weighs approximately 300kgs); and another few days to make five of those bales. This is the number to be reached before those bales can be sold: indeed, the large recycling trader to which those bales will be sold does not accept sales of under 1.5 tons of material. Once the owner of the warehouse has accumulated 1.5 tons, he thus loads the bales on one of his trucks, and goes to an industrial area in the northern suburbs of Mexico City to sell them.

In this warehouse, the bales are opened, and the cardboard is looked at by workers, to clean it once again, separate it by colour, and to make even bigger bales (above a ton in weight). Later in the day, a trailer from a different company will come to pick up a dozen of these bales, to be sent to a recycling facility in the state of Queretaro, two hundred kilometers away (see Figure 5.5). In this facility, the cellulose will be extracted from the cardboard, and will be used to make disposable paper napkins, which will be sold to supermarkets for national consumption.

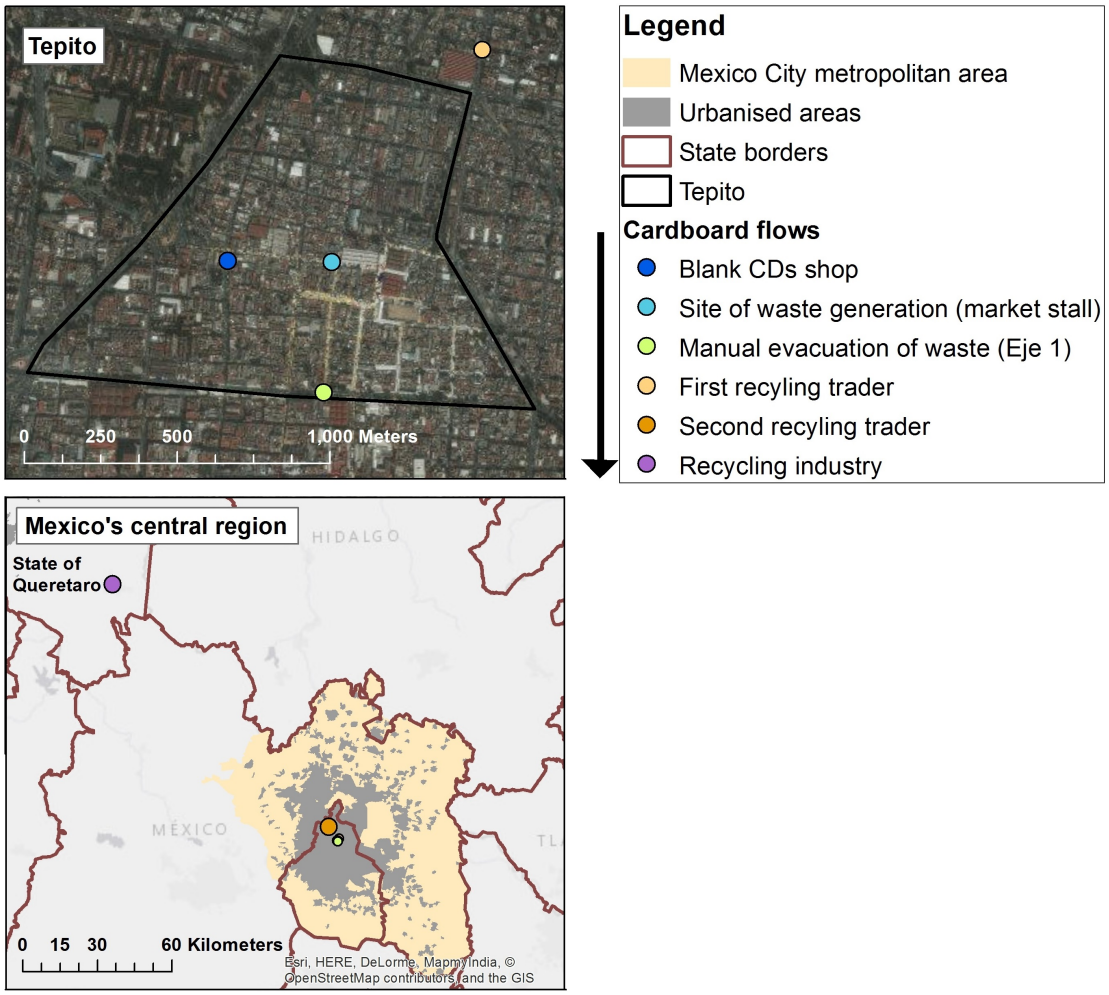
Figure 5.4: A voluntary helper separating cardboard

Source: Author's own, 2015

Figure 5.5: A trailer leaving the large recycling shop, transporting cardboard to a recycling factory

Source: Author's own, 2015

Figure 5.6: Cardboard flows



Source: Own elaboration

Vignette 2: Flows of PET plastics

It is a Saturday, a group of young people are playing football at the local sport centre, in the heart of Tepito. The coach hands water bottles to the team throughout the game. At the end of the training session, the sport centre manager comes by and asks the students to remember to put these water bottles in the dark rubbish bag on the side of the rubbish bins, rather than in the bin itself. The students do so before leaving. A few hours later, the manager is closing up; he takes the dark rubbish bag, now full of plastic water bottles, and leaves it next to the entrance. His friend comes by, picks them up and thanks the manager. He is a waste-picker on his daily route: first, his neighbours, then the hospital, the sport centre, and finally a market stall where an acquaintance always has cardboard for him. He carries all the recyclable material he collected on his trolley, and once his route is done, heads to the local recycling shop. He can carry up to sixty kilograms of waste on this trolley, which is the amount he will sell that day. Just before arriving, he stops in a quiet street and checks the materials: first, he has to make

sure all the water bottles are empty, so he checks them one by one. Then, he has to separate the materials his neighbours left him: the metal cans go in one bag, the paper in another, and the plastic bottles go in two different bags (HDPE and PET). He also makes sure there is no other material mixed in the bags. Once this is done, he reaches the recycling shop and he unloads the recyclables, which are weighed separately; this is because each material has a different price. The recycling shop workers check the quality of the materials (whether they are clean and well separated) and the owner pays him his due.

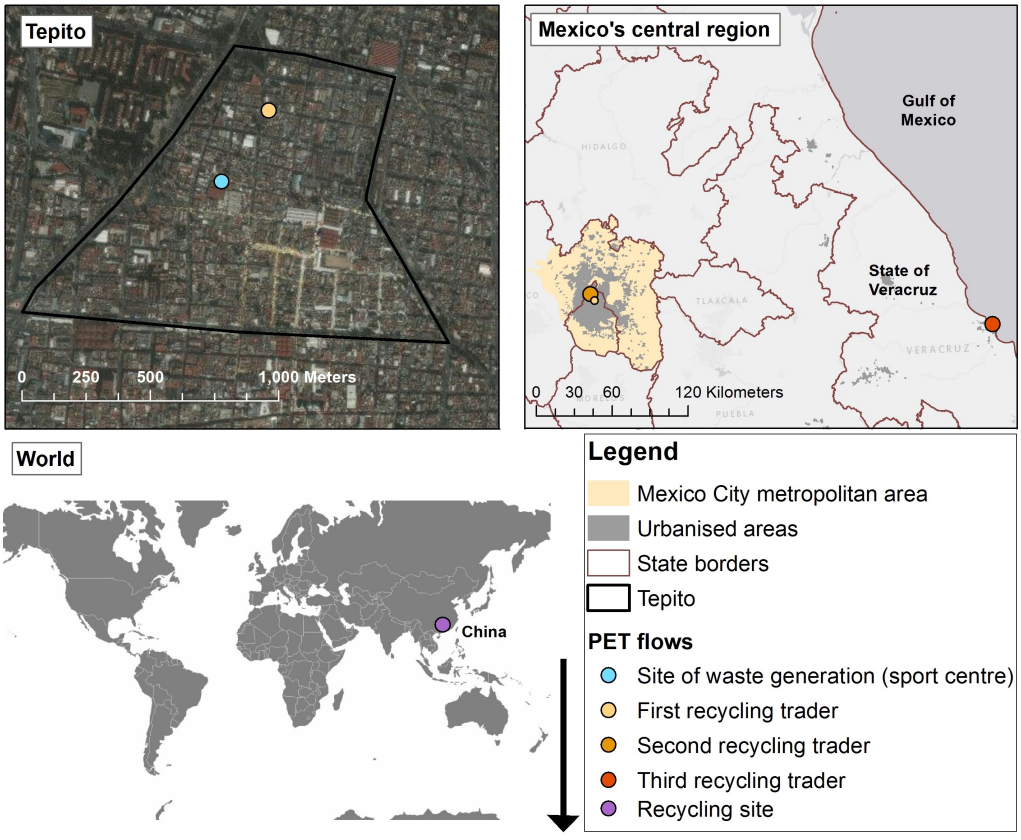
The workers now have to further separate the PET bottles they just bought: their buyer has just called them to let them know the new rules: some PET bottles have a label which is made of a plastic unsuitable for recycling: these labels have to be taken off and thrown away. Besides, the transparent PET can no longer be recycled along the green PET, so they have to be separated as well. Thus, the workers settle in the street in front of the warehouse, with big plastic containers (see Figure 5.7), and start separating the PET bottles by colour, and when necessary, take off the labels. Once this is done and they have filled a container, it has to be loaded onto the truck, that will be used to transport the PET where it will be sold. To do this, workers use a forklift; they have to be on the forklift with the container, so that they can unload it in the truck (see Figure 5.7).

After a few days, the trailer is starting to fill up; it has to be taken to the larger recycling shop. The owner and one of his workers jump in the truck and drive to an industrial area in a northern suburb of Mexico City, ten kilometres away; there, they sell the plastic bottles. In this facility, the plastic bottles will be compacted, and sent to be put on a train to Veracruz, a port in the Gulf of Mexico. The plastic will be put on a boat to be sent to China, where the plastic will finally be recycled.

Figure 5.7: Getting PET bottles ready for transport in a recycling shop

Source: Author's own, 2015

Figure 5.8: (PET) plastic bottle flows



Source: Own elaboration

Vignette 3: Flows of aluminium

In their home in the heart of Tepito, a family is sharing a pack of soft drink cans. Once they finish drinking, they throw the cans away in their rubbish bin. At night after dinnertime, the contents of the rubbish bins are deposited on the street corner. A few hours later, once the streets empty, a waste picker is starting to work: she is only carrying a large dark, sturdy rubbish bag with her, and will not stop before she fills this bag. She starts in her usual street, and opens the bags containing the rubbish deposited by her neighbours. In some she finds nothing, yet in others she finds recyclable materials she knows she can sell. In this one bag, she finds three drink cans, a shampoo bottle, and a food tin can. Once her bag is full, she goes back to sleep and waits for the next morning. She stores her full rubbish bag in her kitchen, to avoid having it stolen during the night (because of this, she usually gets cockroaches in her kitchen). In the morning, she heads to the local recycling shop (Figure 5.9). There, she has to select the materials she gathered: in broad daylight, she checks again whether the material is clean. One of the drink cans she gathered is full of yoghurt; this will not be accepted by the recycling trader. She throws it away in a nearby bin. She then goes in the recycling shop. One of the shop's workers weighs the recyclables on a floor scale, and pays the waste-picker her due.

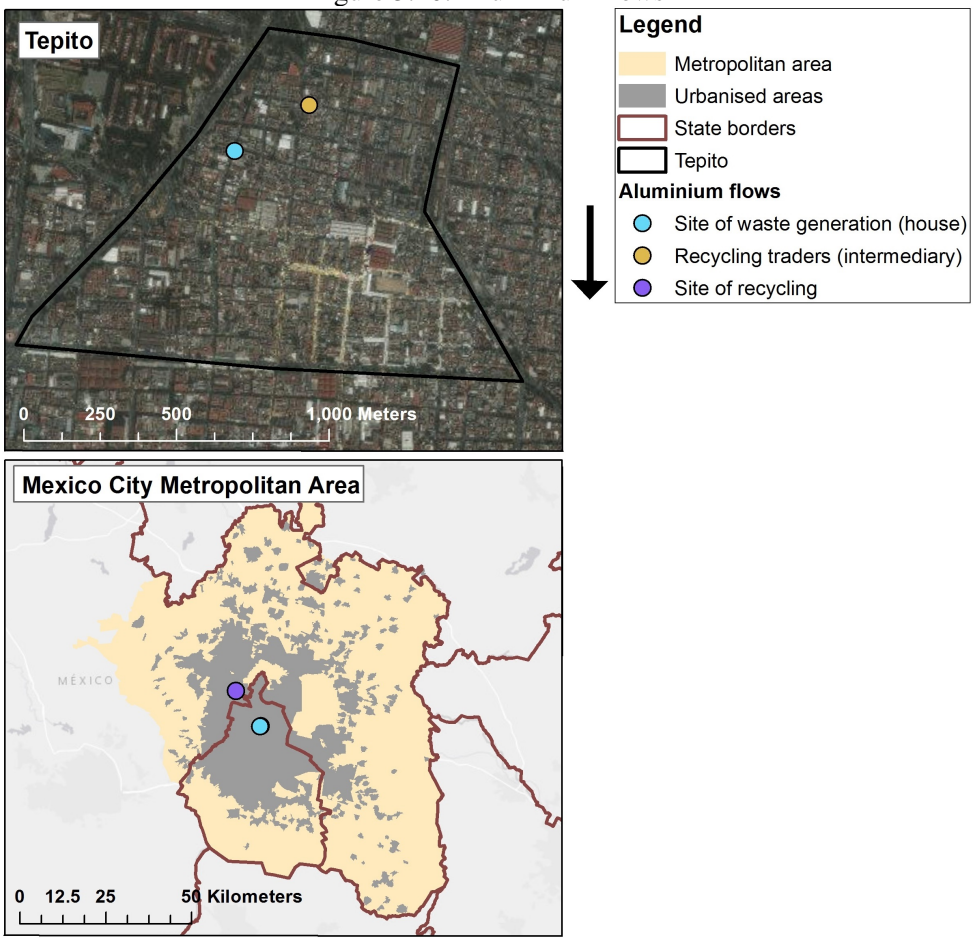
As the cans do not weigh much, and the production is not high, the recycling shop owner decides to store them for a while, until they reach a weight of eight hundred kilograms. It would not be worth it to drive all the way to his buyer's warehouse for less than that, because of the cost of transporting the material: better wait until the truck is full, and sell a bigger quantity of cans for the same spending on gasoline. Sometimes it takes up to a month to reach eight hundred kilograms; in the meantime, the cans are stored in the recycling shop, in big plastic containers, attached to the roof structure (see Figure 7.6, p.216).

Once ten of these containers are filled, they are loaded onto the truck and taken to be sold in Tlanepantla, a neighbourhood in the northern outskirts of Mexico City. It is the furthest that this recycling shop owner goes to sell any material: sixteen kilometres. There, he sells the cans not to a larger recycling trader, but directly to a recycling factory; by eliminating one intermediary, he gets a better price. In this factory, the cans are melted into new aluminium sheets, which will be sold in hardware stores throughout the metropolitan area.

Figure 5.9: A waste picker and her trolley

Source: Author's own, 2015

Figure 5.10: Aluminium flows



Source: Own elaboration

Chapter 6

Identification of formal and informal waste practices in Tepito's waste management

The starting point of the thesis was the absence of data about the role of informal actors in urban environmental management and sustainability. The previous chapter, looking at discourses of civil servants around informality, points towards some explanations as to this absence of data: informality is made invisible through the policy process which favours a vision of sustainability oriented to green growth. As a result, informal actors and informal flows of waste remain invisible from the Waste Inventory (that is, the official dataset on Mexico City's waste management). The remaining empirical chapters of this thesis aim to contrast this vision of the waste management system as it is displayed in formal statistics and institutional discourses, with the findings of research undertaken on the ground, in the neighbourhood of Tepito. The Vignettes provided anecdotal stories of how recyclable waste is typically handled in Tepito. I will make reference to them throughout the empirical chapters. In this chapter, I track waste flows through the neighbourhood to provide a snapshot of Tepito's waste metabolism. By "following the flows" of waste, I document how they are disposed of, where, by whom, and how much of it. By doing so, I answer the first research question of this thesis: *How does waste flow through the neighbourhood of Tepito?* In the following chapter, I will use an ethnographic approach to look at the lives of formal and informal waste handlers, in order to explore the role of informality in Mexico City's waste management system.

The structure of this chapter goes from the general to the particular: I start by presenting a conceptual map of Tepito's waste flows and the actors involved in them. I then quantify those flows (a result from the survey conducted as part of the fieldwork). The quantification of the flows is a crucial part of this research, as it represents an important research gap. As mentioned in Chapter 3, institutional data on waste only accounts for governmental waste management and ignores the role of both informal actors and the private sector. In addition, information publicly

available only provides quantification of flows at the municipal level - this means no data is available specifically for the neighbourhood of Tepito, or any other neighbourhood. Overall, this first section documents the existence of non-governmental waste handlers, as well as the activities they participate in, and the proportion of waste which is handled by those informal actors.

In the following section, I present the governmental waste collection system in the context of Tepito. Although the waste flows may at first appear similar to those presented in Chapter 3 (looking at Mexico City generally), I focus on the identification of informal workers and practices within the waste collection system - looking at informal work and informal cash flows.

In a last section, I turn to informal flows of recyclable material. These are dealt with separately from the governmental flows, because as recyclable material is extracted from waste, it follows an entirely separate chain of management and disposal.

6.1 Identifying and quantifying Tepito's waste flows

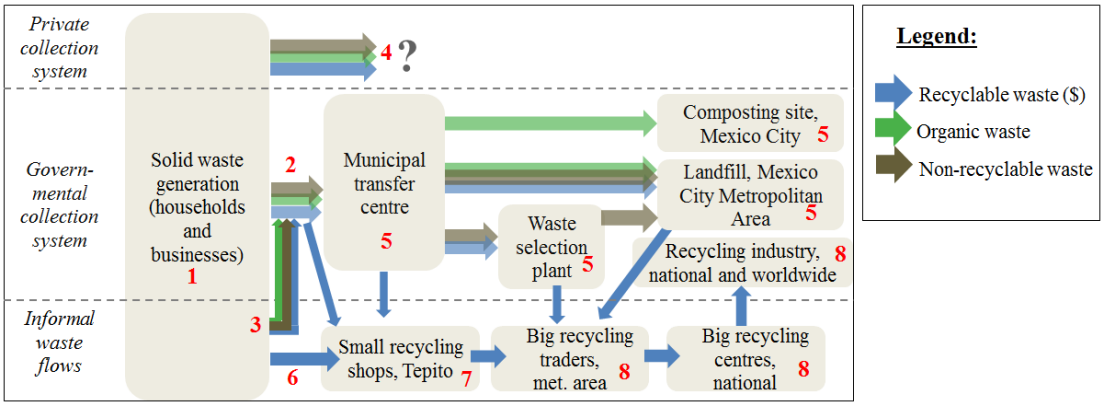
6.1.1 Conceptual diagram of waste flows

Figure 6.1 represents the flows of domestic waste produced in Tepito. It includes flows of different types of waste (recyclable, organic, non-recyclable) from the moment they are discarded as waste all the way to their final disposal (or recovery) site. This diagram has two key differences to that which was presented in Chapter 3 (Figure 3.8, p.76); these appear with a stronger colour in the diagram and are discussed further below. I focus here on explaining the differences between the two diagrams, which illustrate two findings from my field research.

Participation of informal street sweepers (Actor 3) in waste collection. The first finding shown in the diagram is that the municipal team is not always the only actor handling waste collection: in some cases, privately-hired street sweepers (actor 3) remove waste from particular streets and transport it elsewhere for the municipal team to collect it. This finding will be explained in depth in Section 6.2 (in this chapter). More generally, Section 6.2 focuses on informal practices which contribute to the (formal) governmental waste management system.

Informal recycling. This is where the diagram is most changed: through my field research, I documented the existence of a range of waste handlers and intermediaries, forming a "recycling chain" linking up the informal waste-pickers (actor 6) to the recycling industry (actors 7 and 8). This informal recycling chain is the focus of Section 6.3 (in this chapter).

Figure 6.1: Conceptual diagram of waste flows in Tepito



List of key actors:

1. Households and small businesses
2. Municipal waste collection team (garbage-men)
3. Privately-hired and/or informal street sweepers
4. Private waste collection companies
5. Government infrastructure: municipal transfer centre, waste selection plant, composting site, landfill
6. Waste-pickers
7. Small recycling businesses
8. Bigger recycling businesses (different sizes) and reycling industry

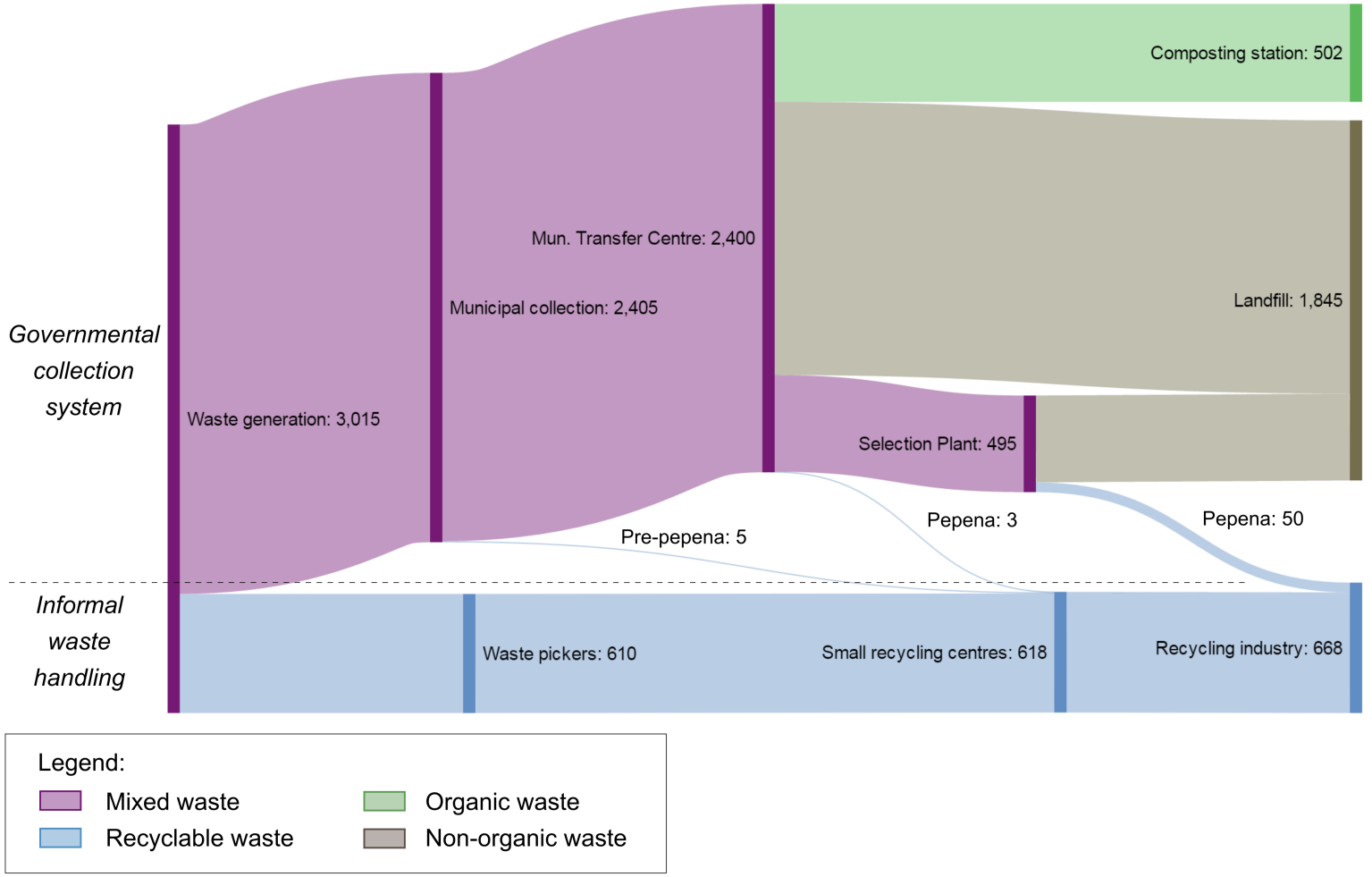
Source: Own elaboration

6.1.2 Quantification of Tepito's solid waste

Quantification of waste flows. Through conducting surveys (see Chapter 4 for methodological process), I was able to estimate the proportion of governmental (mixed organic, non-organic and recyclable) and informal (recyclable) waste flows for the neighbourhood of Tepito.[1] This data was combined with secondary data on the physical composition of waste (Duran Moreno et al., 2013) in order to estimate the diversion from landfill achieved by informal waste handlers. Flows occurring after the Municipal Transfer centre are estimated based on governmental data (SEDEMA, 2015) (and particularly, the percentages of waste received in the Municipal Transfer centres being sent to composting sites, selection plants and landfills). Quantified waste flows are presented in a Sankey diagram in Figure 6.2.

[1] Private waste flows are excluded as it was not possible to collect data. See Section 4.1.2 for methods.

Figure 6.2: Sankey diagram - Destination of waste generated in Tepito, in tons/month



Source: Own elaboration

The analysis of survey data reveals that 80 tons of waste are collected everyday (or 2,400 a month) by the municipal collection trucks in Tepito and reach the Municipal Transfer Centre (this is excluding any recyclables being separated and sold off by the municipal team). Assuming a population of 35,886 (according to the 2010 census), this represents above 2.2kg per day per capita, which is well above the city average (1.5kg per capita per day). This can be explained by the density of commercial activities taking place in Tepito and attracting large numbers of workers and consumers (an estimated ten thousand per day).

Additionally, the municipal employees separate around five tons of recyclables each month that they sell outside the neighbourhood to recycling businesses, on their way to the municipal transfer centre. This activity is called "pre-pepena" (as illustrated in Vignette 1); and is described in Section 6.2. The recyclables handled in this way represent 0.2% of the total waste generated.

In parallel to the governmental flows, Tepito's twelve small recycling shops (actor 7 in the diagram) collect around 610 tons of recyclable material per month, buying from households and waste pickers. This means that out of the 3,015 tons of waste being collected each month, 20.2% are handled by small recycling shops - which means that they never reach the transfer centre or any other governmental infrastructure but are handled entirely within the informal economy.

It is important to note that these two numbers - recyclable waste being handled by informal waste pickers and small recycling shops, and recyclable waste being handled on the collection truck - are interdependent. This is because there are limited amounts of recyclables that can be extracted from domestic waste. Informal waste pickers who work on the street get the first opportunity to extract recyclables, as they reach the waste before it is collected by the garbage-men. Thus, municipal employees can only collect however much is left by the informal waste pickers. In Tepito, the number of waste pickers being high, the possible separation of recyclables by municipal workers is thus limited. In the interview, various municipal employees explain that they do not even bother trying to separate materials, because they know there is barely any material to be collected, as many waste pickers have already taken what they could. However, this dynamic might be different in other neighbourhoods. As a manager who worked in various neighbourhoods of the municipality explains, in the richer neighbourhoods, there may be two or three waste pickers for the whole neighbourhood. In Tepito alone, there are hundreds. This explains the difference between the figures for *pepena* taking place on the municipal truck, calculated here for Tepito (0.2%) and in the official waste inventory, calculated for the whole city (17%). In absolute terms, the Waste Inventory estimates *pre-pepena*

(waste-picking on the truck) to be of one ton per day per truck (as an average for the city); in an interview, a truck driver working in a different neighbourhood reported to collect about 400 kg of recyclables per day on his truck (Wh16, October 2015). In Tepito, the average of five tons per month represents 16kg/day/truck. This reveals a vibrant informal waste-picking activity, which reduces the potential for pre-prepena on the municipal waste collection truck.

Waste composition. The best approximation of waste composition for Mexico City is that of Duran Moreno et al. (2013), based on the analysis of waste samples taken at municipal transfer centres throughout the city (see Table 6.1). In this research, the authors show that in average and for the whole city, about 27% of the solid waste has "recycling potential", that is to say, that it is made up of recyclable materials (although not currently recycled). This figure goes up to 33% for the Cuauhtemoc municipality.[2]

Table 6.1: Waste composition in the Cuauhtemoc municipality and Mexico City, in percentage of total waste generation

Composition of domestic waste	Cuauhtemoc municipality	Mexico City
Materials with recyclable potential	**33.39**	**27.18**
Plastics	13.52	13.16
Cardboard	4.41	4.03
Paper	10.14	5.89
Glass	3.37	2.65
Ferrous metals	1.67	1.16
Non ferrous metals	0.28	0.29
Organic waste	**46.58**	**49.50**
Non-recyclable waste	**20.03**	**23.32**
Total	**100**	**100**

Source: Adapted from Duran Moreno et al. (2013)

By looking at this data, one can assume that the maximum recycling rate which can be achieved in Mexico City is thus 27% (excluding the composting of organic waste), and 33% for the Cuauhtemoc municipality (where Tepito is located). Figure 6.3 shows the waste composition of Tepito if we simply apply Duran Moreno et al's waste composition for the Cuauhtemoc municipality (presented in Table 6.1) to the 2400 tons/month of waste produced in Tepito which reaches the Municipal Transfer Centre.

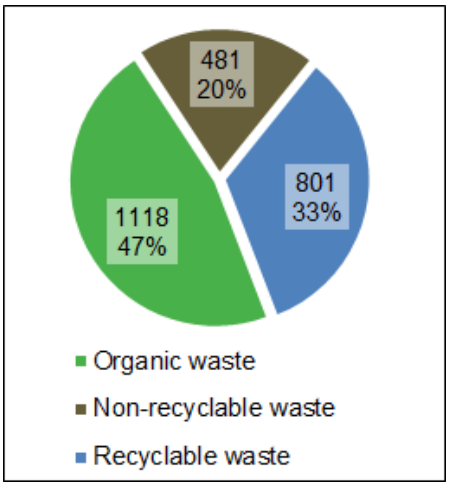
However, in Duran Moreno et al's research, the waste composition is calculated based on waste samples taken at the municipal transfer centres. As a result, this waste composition does

[2]In Duran Moreno et al's research, the waste received in the municipal transfer centres is used as proxy for municipal waste generation. However it is worth noting that the municipal transfer centres receive waste from an area which is almost exactly that of the municipality, but which sometimes differs slightly.

not take into account the recyclable materials that are separated and sold to the private sector *before* reaching the transfer centre: the Sankey diagram (Figure 6.2) shows how the municipal transfer centre only receives a portion of total waste. In the case of Tepito, it is 615 tons/month (or 20.4% of total waste) which is excluded from this sample - and which exclusively represents informal flows of recyclable waste. Therefore, the share of recyclables in the waste composition as presented by Duran Moreno et al. is not representative of the total domestic waste generated.

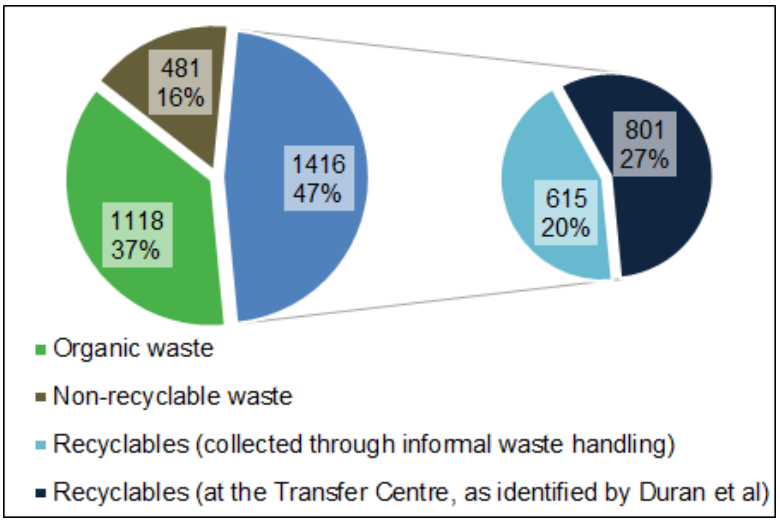
Figure 6.4 presents the same waste composition diagram, now *including* informal flows (that is, adding the 615 tons which are handled in the informal sector, including both the activities of waste-pickers and *pre-pepena*).

Figure 6.3: Waste composition in Tepito in tons/month and in percentage of total waste, excluding informal flows



Source: Own calculations based on (Duran Moreno et al., 2013)

Figure 6.4: Waste composition in Tepito in tons/month and percentage of total waste, including informal flows



Source: Own calculations based on (Duran Moreno et al., 2013)

What do we see when we compare the two graphs? The generation of organic waste and non-recyclable waste remains the same (in absolute numbers). Only the absolute generation of recyclable waste increases. In terms of percentages of total waste, we see that "potentially recyclable waste" increases from 33% to 47%. The graph also allows us to compare the amount of waste that is potentially recyclable (1,416 tons per months) with that which is actually recycled by informal waste-pickers (615 tons per month): these figures show that the recycling rate in the neighbourhood of Tepito is 43% of recyclable waste. When looking at all the domestic waste (including non-recyclable and organic), the waste recovery rate (or, diversion from landfill) reaches 40% of the total waste, based on recycling and composting. This rate is higher than that which is presented in the official waste inventory for Mexico City (around 19%) (SEDEMA, 2015).

If we extrapolate this increase to the whole city, it could mean that potentially recyclable waste does not represent 27% of total waste, but up to 38%. However, this extrapolation is not straightforward. Firstly, the calculation of waste composition for Tepito is not exactly accurate, due to the data available to conduct the calculation: the data provided by Duran Moreno et al is presented for the Municipal Transfer Centre of the Cuauhtemoc municipality, which means that it is an average for the whole municipality. However, waste composition differs greatly between neighbourhoods - even within the same municipality -, according to socio-economic level (for household waste) and the type of commercial and industrial activities taking place in the neighbourhood. Indeed, the Cuauhtemoc municipality has great socio-economic disparities among its neighbourhoods, which can be reflected in waste production. Socio-economic levels also impact on rates of informal waste-picking in the neighbourhood which has consequences for the calculations of waste composition. Thus, it is not perfect to combine Duran Moreno et al's waste composition (for the whole municipality) to the Tepito data (one particular neighbourhood in this municipality). In a similar way, there are differences in waste generation and management throughout each of Mexico City's municipalities, and across these municipalities; this reduces the possibility to extrapolate data produced in Tepito to the whole of Mexico City. It would thus be more accurate to conduct a household and commercial waste survey at the local/neighbourhood level, rather than use data at the municipal level. Still, this analysis shows the importance of taking informal waste-picking into account when calculating waste composition and rates of diversion from landfill, as excluding informal waste-picking from these calculations mean under-estimating the share of recyclable waste in the total waste generation.

6.2 Informal practices as part of governmental waste collection

This section documents the flows which are collected by the municipal garbage-men and handled by the government infrastructure, that is to say, those labelled "governmental collection system" in Figure 6.1. It focuses on the first step of waste management (waste collection) and aims to identify the informal practices that exist within it.

6.2.1 Structure of the team and daily organisation

The Cuauhtemoc government divides the municipal area in "sectors", providing each with their own independent waste collection team. Tepito is one of these sectors, and is divided in two sub-sectors, each with its own team, meeting daily in the warehouse where the equipment is stored. Each sub-sector is in charge of roughly half of Tepito's streets (see Figure 6.5). The team in sub-sector Gorostiza collects waste in the east side of Tepito, which includes the street markets area; while the team in sub-sector Lagunilla collects waste in the west side of Tepito, which is mostly residential. In total, there are around forty-five municipal employees working in Tepito in relation to waste collection and street sweeping, although the Gorostiza team is bigger: Gorostiza has eight trucks (and has about forty employees) while Lagunilla has three trucks (and about five employees).

Figure 6.5: Sub-sectors of municipal waste collection in Tepito

Source: Own elaboration

The workday starts early, around 5 am. The first person to arrive at the warehouse is the sub-sector manager: the role of the manager is to ensure that the waste collection service runs

daily on all routes, and to man these routes depending on the employees and volunteers present each day. The first task is thus to assess the situation: in the Gorostiza sub-sector, the manager rides his bike throughout the neighbourhood to see where waste was deposited that night. When employees arrive, the manager assesses the composition of the team (who showed up, who did not, who will be late) and makes up teams of workers to attend each collection route.

The collection routes are determined by the number of trucks. Each truck has a designated route; however these may change if a truck is missing (because it is broken or the truck driver is absent, or stuck in traffic) in order to attend all the streets of the area. The trucks are a scarce resource: trucks are handed over on an *ad hoc* basis, by the municipality to individual employees who become their driver. This driver then becomes in charge of the collection route designed for the truck.

Depending on the size of the route and the quantity of waste accumulated overnight, truck drivers may get between one and three extra workers (called pawns[3]) to help them run their route (see Figure 6.6). The workers who are not helping a truck driver, go and sweep the street. They use a broom, shovel, and two big metal buckets on a rolling structure, and they walk around the street picking up waste (see Figure 6.7). Then, they empty the waste into the nearby trucks.

The teams on the trucks are complemented by voluntary helpers, who are not municipal employees (two of them can be observed working alongside garbage-men in Figure 6.8, they are also mentioned in Vignette 1). These are people who are allowed to follow the truck, and to select recyclable waste from the truck. They do not earn a wage; but they are paid through the sale of recyclables that they extract from the waste. The voluntary helpers are not officially recognised as part of the municipal team, as they are not on the payroll: one interviewee, civil servant in the municipality, refused to acknowledge their existence while being recorded, however did make gestures to apologise and confirm that he knew about them, he just could not be recorded on tape talking about them (Mun9, Feb. 2016). However on the ground, they are considered part of the team by all workers: they work the same hours, are sometimes given the same uniform, and they are paid by the truck driver for their work (indeed, the fact that voluntary helpers cannot be distinguished from garbage-men in Figure 6.8 reflects this *de facto* integration between the two groups of workers).

[3]The word "pawn" (*peon* in Spanish) is defined as "a person who does hard or boring work for very little money, a person who is not very important in a society or organization" (Mirriam-Webster, 2017); this word was first used to refer to landless farmers in Latin America. In this context, it is used to design the workers at the bottom of the team's hierarchy.

Figure 6.6: The municipal waste collection truck, and employees

Source: Author's own, 2016

Thus, the municipal collection team is made up of (in hierarchical order): the sub-sector manager, the truck drivers, the pawns, the street sweepers, and the voluntary helpers. Although the voluntary helpers are unwaged, their work supporting the garbage-men is nonetheless important: indeed, it is particularly essential in Tepito, as the municipal team suffers from a long-term lack of human and financial resources to do their work properly, as one sub-sector manager explains:

"We are not opposed to provide a good service, however we need the tools to do it well. We currently have nine routes which we have to sweep, however currently the majority is not swept, because there is nobody to do it. The people who used to be in charge of sweeping those streets, we are sending them to help the trucks. If we sweep the streets, we cannot attend the piles of waste - and you've seen how the piles look after a day, so you can imagine, if we left them two or three days, it would be a chaos, a chaos. So yes, we urgently need a renewal of the vehicle fleet, more trucks, people to work, and... well, even shovels, the majority of workers buy their own shovels. We used to not have brooms, but now we have brooms [...] which the workers made themselves." (Wh13, October 2015)

In this extract, the interviewee explains how the main challenge to providing a good service is the lack of resources: in 2015, the municipality reduced the size of the municipal team

Figure 6.7: Equipment of a municipal street sweeper

Source: Author's own, 2015

through a programme where employees can retire, yet they are not replaced by new employees. As a result, the team in the Gorostiza sub-sector has lost seven employees in one year, dropping from fifty to forty-three employees. This shows how important it is that the team is able to benefit from the additional help provided by the "voluntary helpers".

6.2.2 Waste collection in residential areas

Waste collection in the absence of *toque de campana*. In Tepito, there is no *toque de campana* (the traditional collection system where households hand their waste directly to the garbage-men) except in two small streets. This is for two main reasons. Firstly, there are not enough trucks and municipal employees to carry out this daily route in each street; secondly, garbage-men believe that many households would refuse to pay a tip in order to throw away their waste; and that they prefer to throw away the waste directly in the street at any time of the day they want.

The custom in Tepito is thus to deposit the waste at street corners, which slowly accumulate to form mountains of waste (for instance, see Figure 6.9).[4] Then, the municipal team merely

[4]How this custom came to be in Tepito, and how it could change, is a debated topic of discussion in the neighbourhood. On the one hand, the municipal team argues that they do not have time to carry out a *toque de campana* because they spend most of their day collecting waste from the street corners. If households would stop throwing their domestic waste everywhere and at any time of the day, the situation could be solved. In this discourse, the

Figure 6.8: Municipal workers and voluntary helpers working alongside a collection truck

Source: Author's own, 2015

picks up waste from these spots once a day during their collection route, using brooms and shovels to dump it in the truck (see Figures 6.8 and 6.9). One can observe on this photograph that the waste is disposed of either in a plastic bag, or in no container at all; and is not separated (between organic and non-organic).

problem comes from the citizens' behaviour. I have been told by a civil servant: "people in Tepito are not educated. It's a bad habit that illustrates a bad education" (Mun4, March 2015). My observations suggest, however, that this situation be better explained by the antagonistic relationship between Tepito residents and representatives of the state, as described in Section 5.3.2.

On the other hand, another narrative exists, in which households are faced with a situation where the only alternative to throw out waste is to deposit it on the street; because of the absence of a daily *toque de campana*. From this perspective, the problem would be solved if the municipal team had more resources to carry out a proper collection service. This points to structural issues in the way municipal resources are distributed and used. My observations do confirm this perspective to some extent: indeed, the space pictured in Figure 6.9 is actually the sidewalk right in front of the garbage-men's warehouse: throughout my visits to the municipal team I spent quite some time at this particular spot, and observed how people actually come to drop their garbage right in front of the municipal warehouses, and say a friendly hello to the municipal team while doing so. It is acknowledged by both parties that this is the best they can do: they have all the best intentions but cannot deliver their trash directly to the truck (as they are supposed to) if there is no *toque de campana*; thus, coming to drop their garbage to a spot which can be easily cleaned by the garbage-men is a sign of respect. Two small residential streets in Tepito are an exception, as they do benefit from a *toque de campana*. In these streets, the situation is indeed better, as many households do hand in their waste to the municipal team upon hearing the bell. However, there are still some mountains of waste forming on those streets corners (although much smaller than in other streets). This means that there is more work to do for the municipal team, which has to carry out street sweeping to remove the mountains of waste in the morning, as well as the *toque de campana* in the afternoon. The situation in these two streets is an indication that the two perspectives on the issue of waste dumping are both true to some extent; as the two practices (dumping on purpose, vs dumping by absence of alternative) co-exist within the neighbourhood.

Figure 6.9: Waste on a residential street

Source: Author's own, 2015

The absence of *toque de campana* is problematic on various grounds. First, and as pictured in Figure 6.9, there are constantly mountains of waste in the streets of Tepito. This has obvious public health impacts, especially due to the rats, stray dogs, cockroaches and other animals feeding from this waste. The municipal collection team also suffers from potential health hazards, as they have to remove this waste manually, and thus come in contact with open bags of rubbish as well as the animals aforementioned.

Beyond the public health concerns, the absence of *toque de campana* means that there is no direct contact between citizens and the garbage-men. One of the consequences is that the employees do not receive tips for their work (as would happen in other neighbourhoods). This is problematic, as tips are usually used (in other neighbourhoods of the city) to pay the voluntary helpers, and to save up in order to be able to afford the truck reparations and maintenance costs.

Another consequence is related to the separation of waste (between organic and non-organic): in order to improve waste separation practices in the city, Mexico City's garbage-men are tacitly in charge of teaching (and reminding) households of separating their waste. However, in the case of Tepito, in the absence of *toque de campana* there is no direct contact between citizens and municipal workers; as a result, the waste is generally mixed (organic and non-organic)

within the same mountains of waste. At this point it is too late for a separation to be undertaken, and the waste is thus sent to landfill rather than used in compost or recovery schemes.

The difficulty of *pre-pepena*. A customary task for the waste collection team throughout Mexico City is that of the *pre-pepena*, which is waste-picking on the municipal truck. The street sweepers, voluntary helpers and some pawns may separate material which is outside garbage bags, as well as opening garbage bags in order to gather recyclable materials. They store it in different containers in the truck, and go and sell the material at the end of the route. The material is sometimes sold locally by the voluntary helpers (who use a trolley to reach the recycling shop); alternatively it can be kept on the truck, and sold by the truck driver outside the neighbourhood (on the way to the municipal transfer centre). On Figure 6.6, there is a large white plastic bag attached to the top of the truck: it serves as a container for the recyclable material that is separated while on the collection route (mainly cans and plastic bottles). Figure 6.10 shows how the recyclables are separated and stocked on the roof of a municipal truck. The earnings from this activity are used to maintain and improve the waste collection service: part of it is shared among the workers (this is particularly important for the voluntary helpers, as it is their sole source of income); another part is saved in order to pay for future truck repairs (but more on this later).

Figure 6.10: Separating and stocking recyclable waste on the collection truck, for later sale

Source: Author's own, Narvarte neighbourhood, Mexico City, 2016

Although this activity does exist in Tepito, it is much less than in other neighbourhoods, because of the lack of time and resources to conduct the activity. Waste workers have a limited time-frame, and a scarcity of resources to do their job properly. Because of this, they work as fast as they can; and one way to save time is to merely collect waste and dump it in the truck, without opening the bags to check for recyclables.[5] Separating waste is time consuming, and there is not enough time: there is barely enough time to finish one's route on time, let alone collect waste. As the manager puts it: "Our principal enemy is time, we are always in a rush, what we want is to finish [our route]. And it's not that ten or fifteen pesos wouldn't be useful, but it's not possible, because of the the type of job that is ours here in this sector" (Wh13, October 2015). The ten or fifteen pesos he refers to are the ones the team could earn by the sale of recyclables.

Of the eight truck drivers who participated in the survey (out of ten trucks in the neighbourhood in total), four mentioned that they separated recyclables. Out of those, two said that this activity was only carried out by voluntary helpers, while in the other two cases the driver also participated (and helped sell the materials). The survey showed that the amount of recyclables separated on the truck is extremely low in Tepito compared to other neighbourhoods (see Section 6.1.2).

6.2.3 Waste collection in the market area

Tepito's waste collection is determined by its use of public space: in the southern part of the neighbourhood is the market area. There, the market workers have taken over most of the public space to install semi-permanent metal structures for their stalls (which are not taken down at night). This restricts vehicles' access to the streets (see Figures 3.11 and 3.12, p.86), including municipal waste collection trucks.

Over the years, the informal street associations (who manage the informal street markets) have negotiated waste management responsibilities with the municipality. The street associations' aim was to avoid having to remove their street stalls' metal structures at night; as this is extra work for the market workers. However, this restricts access to the municipal large collection trucks. Thus, the associations offered to hire street sweepers to remove the waste produced in these streets, and to move it to larger streets on the edges of the market, easily accessible by the municipal collection trucks.

The municipality agreed, and it is now street sweepers, hired by the informal associations, who are in charge of waste collection in the market streets. During the day, the streets are filled

[5] Once the waste is dumped in the back of the truck, it is too late to separate it, as most trucks have an integrated compactor which, by compacting the waste bags, destroys them and the integrity of recyclable materials. They also become mixed with organic waste which means they are not clean enough to be sold as recyclables.

with market workers and customers, and waste collection is impossible. It is only after 7 pm, when the markets shut down, that the middle of the street can be used for other purposes (see Figure 6.11). And it is at that time of the day that the waste collection process starts: from 7 pm on, two types of waste start accumulating in the street. On the one hand, there is the waste produced by the markets themselves: this is mainly cardboard and plastics (from the packaging of the products sold in the markets) as well as Styrofoam boxes, generally used in Tepito to sell hot lunches to local workers (see Vignette 1). On the other hand, households who live on those market streets also take advantage of the evening to take out their waste, which they deposit in the street. In both cases, waste is not separated at all, and is either deposited in small plastic bags, or without any packaging at all - similarly to the residential streets situation. These two types of waste accumulate in the street in the evening (see Figure 6.12).

Figure 6.11: A market street, after 7 pm

Source: Author's own, 2015

The street sweepers work all night, between 7 pm and 6 am, to ensure all the waste being deposited throughout the night is removed in time for the garbage-men's morning route. They work in teams and use large brooms to push all the waste through the streets. The brooms are the most efficient tool in this case, mainly because the waste is not well kept in bags or rubbish

Figure 6.12: Waste on a market street at night

Source: Author's own, 2015

bins, but rather accumulates on the floor. They have to work quickly, as they have only about an hour between the end of trading hour and the garbage-men's evening shift. Later in the night, they remove the domestic waste, taken out and left on the floor by the residents of the streets' buildings. This waste is picked up by the municipality's early morning shift. If they fail to move all the waste before the municipal shifts, then the waste is not picked up, and the workers cannot set up their street stall the next morning. Because of this time pressure, they generally do not have time to separate waste (and select recyclables for later sale). As one interviewee explains, "the most important thing is that the street is clean at all times" (Wh4, October 2015); the street leader pays them a wage for the street to be cleaned, not for the separation of waste. Sometimes the sweepers select the material that is easiest to pick up because of its large size: cardboard. The smaller items, mixed up with non-recyclable waste (PET, polyethylene, pieces of metal or glass), are left to be picked-up by the informal waste-pickers. This is not only because of time constraints, but also as a gesture towards waste-pickers. Street sweepers know that there are waste-pickers waiting to select waste, and it would be unfair to steal their livelihood: "they also need to work", explains one of them (Wh5, October 2015).

To sum up; the municipal team, with the tools and vehicles at its disposition, cannot physically enter the commercial streets to carry out its duties. Thus, the waste collection service

provided by the municipality is dependent on the work of street sweepers hired by informal associations. The quality of the service provided to residents, and the efficiency of the system, is thus dependent on the work of these informal associations, over which the municipality has no control. And indeed, observations (confirmed by informal chats with residents) show that the quality of waste collection services varies from street to street, depending on how well the street sweeping has been organised by the informal associations.

6.2.4 The role of the informal economy in municipal waste collection

What does examining the work of the municipal waste collection team, tell us about the role of informality in urban service provision?

Informal work. The municipal waste collection team relies on informal work to function. This is true in two instances. Firstly, the informal street sweepers provide a waste collection service where the municipal team is unable to do so. This is shown to be the case in various Mexican cities by Medina (2005), who argues that informal waste collectors provide an important service in low-income communities where a formal service is lacking. This may be due to physical constraints (as in the case of the street markets, where the municipal trucks cannot physically enter the streets) or monetary ones (informal neighbourhoods may not pay local taxes, and therefore are not entitled to the service). In those cases, informal waste collection complements the municipality's work.

Privately hired street sweepers and municipal employees negotiate and coordinate their action so that their work does not overlap, and rather complements each other. Thus, municipal employees do not attempt to collect waste in the streets in which the privately-hired street sweepers work. Rather, both groups negotiate an appropriate time and location where the waste can be accumulated and deposited by the street sweepers for the municipality to collect. Usually, the location is the nearest road which is big enough for the municipal truck to drive through (and which is not obstructed by semi-formal market structures) ; and the time is during the night collection route, when there are less activities in the street.

In addition, informal workers also work alongside the daily routes of the garbage-men (these are the "voluntary helpers"). The integration of voluntary helpers to the municipal team has various impacts. First and foremost, it makes the municipal waste collection service more efficient by being more flexible and redundant; informal workers help out when there is more work, or less workers (for instance, when a garbage-man is off sick). Secondly, voluntary helpers reduce and share the workload. They also generate their own income (and thus add value to the waste management process) by selecting recyclable materials. Finally, this practice helps generate livelihoods for the most people possible: voluntary helpers tend to be family members

or acquaintances of the municipal employees in need of a job. These are arguably positive impacts for formal and informal workers. This coordination also has positive impacts for the efficiency of the waste management system as a whole: the wide diversity of waste handlers (public or private, organised or independent, working full time or on an as-and-when basis) means that each group can address a particular task within the waste management system - a task that another actor might not be able to perform. For instance, municipal employees cannot enter some streets of the neighbourhood with their trucks; this is where the street sweepers can be most efficient. Another example is that municipal employees have no time to select recyclable waste. Time is a resource that voluntary helpers have in abundance, which means they can carry out this slow process of waste-selection. Indeed, extracting recyclable materials from domestic waste is hardly economically viable; yet, it is an indispensable task if the - formal - recycling industry is to function at all. It is the informal status of voluntary helpers which allows them to work with the flexibility required to make this activity economically viable (working on a one-off basis, with no fixed income) - for better or worse in terms of their working conditions.

Informal money flows. The main consequence of being under-staffed and lacking trucks is that in Tepito, there is no *toque de campana*; and the municipal staff thus has to collect waste that has been previously left on the street corners. One of the consequences is that the employees do not receive tips for their work, as they have no direct interaction with households (as would happen in other neighbourhoods, through the *toque de campana*). The second usual source of income for the municipal workers is the *pre-pepena*, that is to say, the sale of recyclables selected on the collection route. However, employees have very little time to separate recyclables; this activity is thus mainly carried out by voluntary helpers. In addition, waste-picking tends to generate less earnings in Tepito, because of the vitality of the informal waste-picking activity (described in the next section). In general terms, the more material the *pepenadores* manage to extract from the waste, the less is left for the municipal workers. Indeed in Tepito, the absence of *toque de campana* means that waste accumulates in the street during the day, and waste-pickers have all afternoon and night to go through the trash and extract the most valuable materials before the garbage-men collect what remains.

This is problematic, as these two informal cash flows (tips and money earned from pre-prepena) have a crucial function for the waste collection team: they are used to pay, on the one hand, the voluntary helpers, and on the other hand, to save up for the costs of truck reparations and maintenance costs.

The garbage-men are aware that it is legally the government's responsibility to give maintenance to the trucks. However, historically, the government and the syndicate which represents

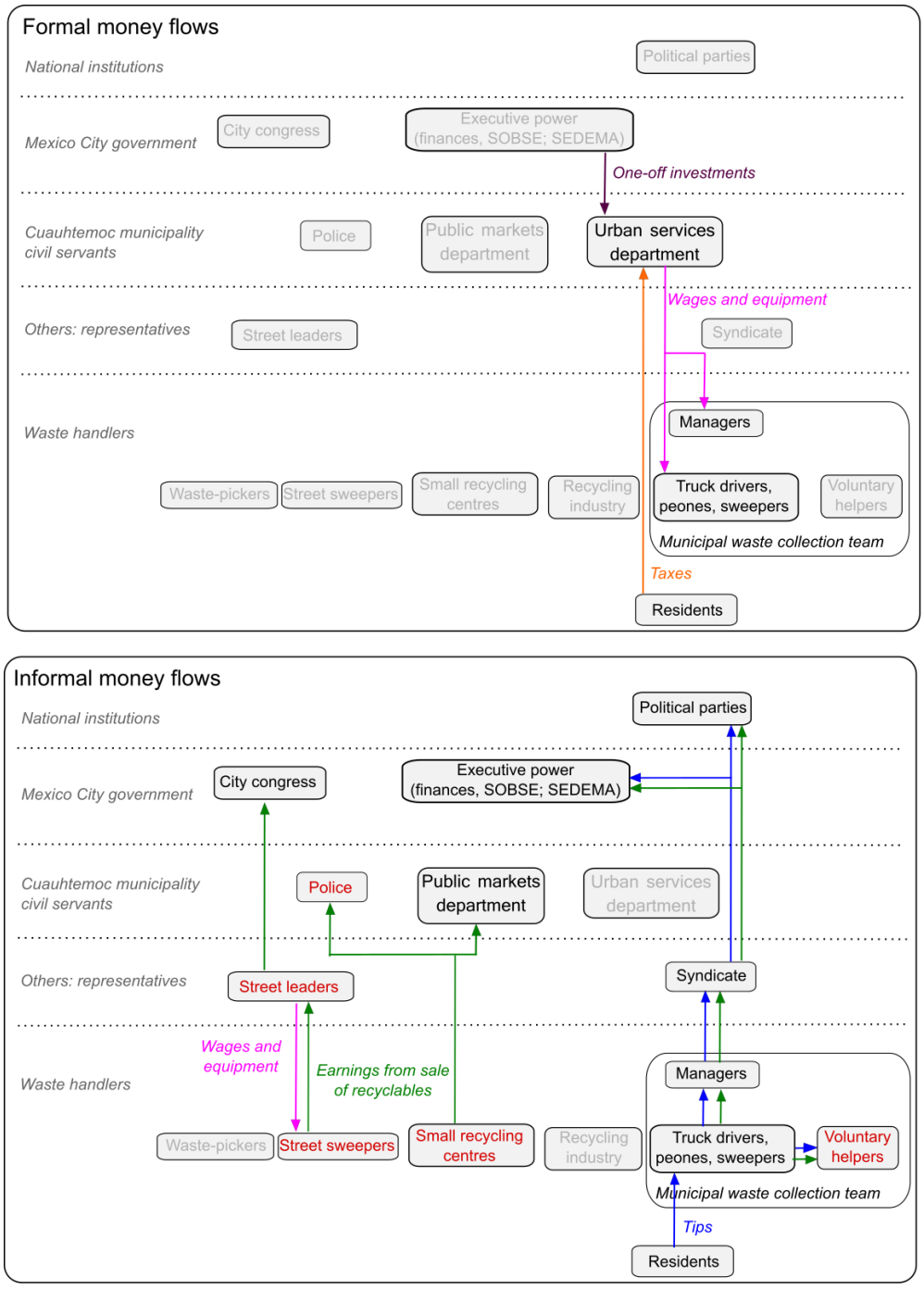
the employees have agreed that the money earned by workers on the side, could be put to that effect. This practice is generalised in Mexico City, yet rarely discussed. However, by looking at the case of Tepito, where these two sources of earnings are compromised, one can see the importance of these sources of informal earnings in supporting the waste management system. Without it, the truck drivers cannot pay the voluntary helpers, which leaves the team understaffed, and arguably decreases the quality of the waste collection service. Neither can they repair their trucks; as a result, two out of eight trucks assigned to the Gorostiza team are out of service, until the team can save enough money to pay for the repairs.

Figure 6.13 presents the role of formal and informal money flows, as described by the garbage-men themselves (formal actors appear in black and informal actors in red). The image at the top represents the formal money flows, which is how the system should work in theory: in this system, citizens pay their local taxes to the municipality, who uses part of those taxes to pay for the operation of the waste collection service (wages and equipment) - this is complemented, when needed, by extra investments by the municipality and Mexico City government (for instance, in the case of the purchase of new trucks).

Yet, this is not how things work in Tepito: the situation is best described by the lower image labelled "informal money flows". Firstly, citizens tend not to pay local taxes, particularly those related to economic activities, as most businesses are informal. In parallel, the garbage-men feel they receive less equipment, and less staff members than other neighbourhoods. Therefore, they rely on the informal cash flows to fill this gap. In this informal system, the garbage-men rely on tips, and the earnings from the sale of recyclables, to maintain a cashflow. This is used to pay the voluntary helpers and to repair the trucks. Some of that money is also used to bribe civil servants (through the syndicate), in order to obtain favours (for instance, more staff members or more trucks).

This practice is not specific to Tepito, it is common throughout the city (as Wh16, Mun6, Mun8 and Mun9 confirm); and it is this practice that enables the waste collection service to be maintained. Tepito's specificity lies in the weakness of its informal cash flow system, due to the absence of a *toque de campana*, which means it cannot pay its voluntary helpers nor repair its trucks as it should. Thus, the case of Tepito serves as a case in point of the importance of informal work and informal cash flows in maintaining the governmental waste collection system.

Figure 6.13: Formal and informal money flows, as described by the garbage-men



Source: Own elaboration

6.3 Informal waste handling

Recyclables are handled quite differently from the domestic waste collected by the municipal team: the temporality and spatiality of those flows, the actors participating in it and their motivations are different; despite sometimes crossing paths. Flows of recyclables are those represented in blue and are labelled “informal waste handling” in Figure 6.1 (p.175).

Recyclable materials are produced in households and in businesses throughout Tepito; and, as mentioned in the last section, they are usually disposed of as rubbish, that is to say, mixed with non-recoverable waste in plastic bags. However, recyclable materials follow a very different path from non-recoverable waste because of their market value. Indeed, the recycling industry depends on recyclable materials as an input for its activities; and as a result, there is a global trade of recyclable materials which directly shapes waste flows in Tepito.

6.3.1 Which materials are recycled in Tepito?

The market value of different materials determines whether they are separated from waste to be recycled, or if they are mixed with domestic waste, generally ending up in the landfill. Only those materials which can be separated *in an economically viable way* are recycled.

In Tepito and at the time of the fieldwork, the recyclables that are being separated from domestic waste due to their market value are diverse, and can be divided in three main groups: plastics (such as water bottles, CDs, cellophane or plastic furniture), metals (aluminium, copper, iron, tin, steel mainly) and cellulose-based items (paper and cardboard). The recyclables that are being recycled in Tepito, and their prices (as bought in small recycling businesses) at the time of fieldwork, are presented in Table 6.2.

In terms of composition, results from the survey indicate that the waste collected in recycling shops is - in mass - 68% cellulose (cardboard and paper), 21% plastics, and 11% metal (one has to bear in mind that plastics are much less dense than metals, thus representing more volume per mass). This means that recycled cardboard in Tepito represents 13.6% of total collected waste; recycled plastics, 4.2% and recycled metal, 2.2%.

One can observe that some recyclable materials are absent from this list, one example being glass. Glass is currently not being recycled in Tepito because it is bought very cheaply on the recyclables market: at the time of fieldwork, one kilo of glass was worth 0.40 pesos (0.02 USD). Most waste-pickers do not bother selecting glass for that price, and rather focus on other materials they know they can sell for a better price.

Thus, the flows of recyclables described in this thesis concern only those recyclable materials which have a market value and are considered worthy of selecting by waste-pickers; that is to say, the materials that are actually recycled in the neighbourhood. On the other hand, those materials which are not being separated and recycled because they have a very low market value, despite their being technically recyclable; follow the same path as domestic waste (as they are physically mixed in domestic waste), and end up in the landfills.

Table 6.2: Recyclable materials traded in Tepito and their price as of November 2015

Example of a product	Material	Price per kilo (Mexican pesos)	Price per kilo (USD equivalent)
	Plastics		
Soda bottle	Polyethylene terephthalate (PET)	3.80	0.23
Washing liquid bottle	Green PET, High-density polyethylene (HDPE), hard plastic	3.50	0.21
Cellophane	Low Density PolyEthilene	2.00	0.12
CD	Polycarbonate	2.00	0.12
	Metals		
Cables	Copper	60-70	3.64-4.24
Belt buckle	Bronze	30-40	1.82-2.42
Bike frame	Aluminium	15.00	0.91
Food tin	Tin / Steel	13.00	0.79
Iron (appliance)	Antimony	10.00	0.61
Car motor piece	Heavy iron	2.50	0.15
Cutlery	Mixed Iron (iron sheets, cast iron)	2.00	0.12
Plumbing pipes	Lead	?	
PC motherboard	Silver, gold	?	
	Cellulose		
Textbook	White paper	2.30	0.14
Boxes	Cardboard	1.30	0.08
Magazine	Colour paper	1.20	0.07

Source: Own elaboration

6.3.2 How are recyclables physically separated from general domestic waste?

Some households separate their own recyclable waste in order to sell it. Households tend to separate what they consume within the home (plastic bottles, cans, paper) and sell it regularly (for instance, once a week), in small quantities, to small recycling shops within their neighbourhood.

Workers may do the same at work, and can accumulate bigger quantities. This is true of market workers who keep their products' packaging (cardboard and plastic), as well as public building cleaners (sports centres' cleaners collect large quantities of soft drink plastic bottles), construction workers sell some construction waste (for instance, old plumbing made of copper, or bits of unused metal rods), or school teachers (who sell outdated schoolbooks at the end of the year). These recyclable materials are usually sold to local recycling shops and provide an extra source of income to those who separate them.

As for the recyclables that households throw away, mixed with non-recoverable waste; these are extracted from the waste by waste pickers at different stages of waste management (for instance in the street at night, before collection; on the municipal truck; on governmental waste management facilities; and in landfills) (Vignette 3). In Figure 6.1, these are represented by the blue arrows reaching the small recycling business, whether coming directly from "Waste deposited in the street", or crossing from the government infrastructure (in the municipal collection system) to the informal waste handling.

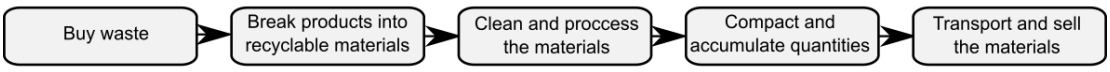
Waste-pickers are women, men and children who earn a living by picking through waste in order to find recyclable materials (principally paper and cardboard, plastics and metals). What waste-picking entails is to pick materials that have a commercial value, separate them, clean them, and sell them to local recycling shops. The first waste pickers with access to waste are those who work on the streets and go through domestic waste accumulated there, before the waste collection truck collects it. They gather small quantities (whatever they can carry on their back or trolleys) and rarely walk more than a couple of kilometres before selling the material to a local shop.

6.3.3 The recycling shops: processing and transporting recyclables to the recycling industry

Recycling shops are small businesses scattered around the city which buy recyclable materials and channel them to the recycling industry. In Tepito, there are twelve recycling shops spread across the neighbourhood. They are usually family businesses, with a few employees at most. One such recycling shop will be described in depth in Chapter 7.

Recycling shops are the main buyer of recyclable waste from the waste pickers, households and workers described above. What their activity entails is to make these recyclable materials usable by the recycling industry. In order to do so, they perform the tasks described in Figure 6.14.

Figure 6.14: Tasks of a recycling shop



Not all recycling shops perform all these tasks. For instance, a recycling shop which does not own a cardboard compactor might sell his cardboard to a neighbouring recycling shop, as it does not have the capacity to create a product that can be sold to the recycling industry directly.

Moreover, these tasks are not relevant for all materials. For instance, paper does not require either cleaning, processing or compacting; it is merely separated, accumulated and transported.

Breaking products into materials. The materials that the recycling shops buy are usually everyday objects, that are made up of many different pieces of materials. For instance, take a DVD player: when a recycling trader buys a DVD player from a local household, its first task is to extract the recyclables from this object. To do this, he breaks open the DVD player. The outer case, made of plastic, is thrown away. Yet one part of this case (around the ventilator), and the ventilator itself, are made of thin iron. These pieces are extracted and kept to be recycled. Then, the motherboard is taken out: motherboards and other electronic components contain very small quantities of silver and palladium. Finally, the cable is taken apart, and inside the plastic covering, some low quality copper is found.

This process is similar for many different everyday objects (such as extracting the metal from a mattress, separating metal and plastics in a clothes hanger, or cardboard from paper in a hardcover book).

Cleaning and processing. Once extracted from everyday objects, materials have to be cleaned before they can be sold as an input to the industry: for instance, take plastic containers made of hard plastic. These can technically be recycled; yet it depends on what they were used for. If the container has been used to store paint for instance, then it is no longer recyclable. Besides, some labels stuck on the containers are made of a different plastic type, which is not recyclable. Thus, each piece of material is looked at individually, to make sure the material is clean; if not, it is either cleaned or discarded.

The next step is processing, which adds value to the materials. Processing can take different forms (making silver from X-ray imagery through chemical transformations and grinding plastic are two examples). These examples will be explained in more detail in the next chapter of this thesis (see Section 7.2.5).

Compacting and accumulating. In order to make further economies of scale during transport, many recycling businesses compact the materials before they travel. This can be done in different ways: cardboard is usually compacted using a cardboard compactor (see Figure 7.5, p.216), while metal is usually compacted manually, using one's own weight. Figure 7.2 (p.214) shows workers loading a metal truck with iron pieces; these same workers then jump on the top of the metal and use their weight to compact the metal and make it fit inside the truck.

Once materials are cleaned and processed, it is necessary to accumulate enough of them in order to sell them in big quantities. This requires storing the materials, sometimes for a few days, and others for a few months. There are two reasons for this: first, the recycling industry

has minimum buying quantities, which are usually set at a few hundred kilos (depending on the material). In the recycling shops, materials are usually bought by the kilogram or even gram; thus, it is necessary to buy regularly from many different buyers in order to accumulate enough to sell to the recycling industry.

The second reason for accumulating is to make economies of scale in transport costs: the most profitable way to sell the materials is to sell the exact volume necessary to fill one truck (whatever that volume, or the size of the truck, may be). This way, less trips are necessary to sell the same amount of materials, which reduces the business' total spendings on gasoline.

Transporting to the recycling industry and selling. The recyclable materials collected in Tepito are sold to bigger recycling shops in the metropolitan area of the city, and end up being recycled (or exported to be recycled) by the recycling industry, which is made up of transnational companies which either recycle in Mexico (paper, cardboard) or abroad (all over the world, mainly China for plastics). The chain of intermediaries which manages waste before it reaches the recycling industry is described in the next section.

6.3.4 The recycling chain: scaling up recycling activities, from the waste-picker to the recycling industry

Family-owned recycling shops act as a key intermediary between the waste-pickers and the recycling industry. However, they are only one of many intermediaries; and this complex chain of diverse actors is necessary for the recyclable waste to reach recycling facilities. In order for recoverable waste that is in the trash, to reach the recycling industry, it has to pass through multiple recycling shops of increasing size. Indeed, there is a complex chain of actors that manage and transport urban waste to the industry. And it is, first and foremost, a necessity created by the geographical and physical constraints of the urban infrastructure: The size of a house or market stall where the waste is produced is different than that of the recycling industry where the waste is recycled. The waste unit is produced by grams or kilos, and is recycled by hundreds of tons. Waste has to be handled in small quantities when it is first produced: it is disposed of daily in the street and thus has to be collected daily from many small units; this has to happen in a multitude of small streets. In the case of Tepito, where most streets are mixed-use (houses inside of the blocks and markets on the street) waste is collected from streets where the semi-permanent market stalls do not allow for a collection truck to pass through. Thus, waste-pickers only collect what they can carry or put on a small trolley. They then walk to the small recycling shops, which are scattered around the neighbourhood, outside of the main market streets.

The small recycling shop's location is thus essential, as it has to be close enough to the main mixed-use streets where waste-pickers collect recyclables. In order to be well-located, small recycling shops have to find intra-urban land, which is usually expensive, and small in size. As a consequence, they themselves are limited in how much recyclables they can buy, store and transport. Their storage capacity is better than that of the waste-pickers: unlike the latter, who have to sell what they gather daily, small recycling shops can store their bulkier items for a few days to a week, and up to a few months for the less bulky ones (such as copper or bronze). They thus buy machinery that is adapted to the size of their plot and their storage capacity. For instance, a cardboard compactor has to make bales of the adequate weight and volume (between one hundred and six hundred kilos) in order to be transported in small pick-up trucks (bigger trailers cannot manoeuvre in these small neighbourhood streets). As a consequence, small recycling shops rely on a various number of intermediaries (bigger recycling shops) to sell their waste. These intermediaries provide a service with machinery that is adequate to receive recyclables by hundreds of kilos: their scales, forklifts, and trailers are adapted for these quantities. Unlike the recycling industry, they are also located relatively close to urban centres, usually in industrial areas in the outskirts of the city. This is primordial: as recyclables are not valuable materials (for instance, PET, which is one of the most expensive plastics, is bought at 3.5 Mexican pesos per kilo, or 0.21 USD), they provide little added value, and thus the associated costs have to be as low as possible. This means that the gasoline required to transport the waste has to be as little as possible; and the more the recyclables have to be transported, the more they lose added value (due to the cost gasoline increasing). Finally, the intermediaries (which can be one or many) sell the recoverable waste to the recycling industry. In this case, selling the material by the hundreds of tons means that there are economies of scale associated with transport; which means that it is economically viable for the recyclables to travel a larger distance, by trailer, train or boat. The industry that actually processes recyclable waste is made up of companies and multinationals which operate all over Mexico (for cardboard and metals) as well as abroad (for plastics). It thus appears that this chain of actors managing waste flows is necessary for the recycling industry to be viable, as much in physical as in economic terms. Table 6.3 conceptually represents this recycling chain; it does not give a full picture of how a particular recyclable material reaches the recycling industry, but rather gives a general idea of how it could reach it.

Table 6.3: Scale of waste flows produced in Tepito

	—– > ..... *sell to* ..... —– >			
	Waste-pickers	**Small recycling shop**	**Intermediates and big recycling shops**	**Recycling industry**
Approximate number	*... in Tepito*		*... in the metropolitan area*	
	One hundred	A dozen	Hundreds	Dozens
Amount of recyclables sold in one go	Grams or kilos	Hundreds of Kilos	Tons	Hundreds of tons
Storage facilities	None, or one's own home	Intra-city warehouse, 100m^2	Industrial area warehouse, 5,000 to 20,000 m^2	?
Transport type	Bags carried on one's back, or put on trolleys	Pick-up trucks	Trailers, train	Train / Boat containers, Trailers
Distance travelled to sell recyclables	100-500m	500m to 15km	15km-1000km	15km-1000km

Source: Own elaboration, adapted from (Guibrunet et al., 2016)

6.4 Conclusions

This chapter has presented an overview of Tepito's waste flows based on research on the ground. The main finding of this chapter is, first, the existence, nature and scale of informal waste management in Mexico City, and in particular in the neighbourhood of Tepito. The different sections show that informal workers participate in a variety of tasks related to waste management. Street sweepers help collect waste in non-accessible streets, voluntary helpers participate in municipal waste collection, and waste-pickers extract recyclable materials from domestic waste. This latter role is particularly important, as recycling is a key activity in the diversion of waste from landfill (a major concern of SOBSE, as described in Chapter 5). Therefore, this chapter shows how informal workers participate in activities deemed desirable by the government, and contributing to (civil servants' own definition of) sustainability. The quantification exercise estimates that 20% of the waste produced in Tepito is recycled through the work of informal waste handlers - this provides an indication that the activity of informal waste handlers is not marginal, as they manage to extract and recover nearly half (43%) of all recyclables produced.

This chapter also presents the key actors and their role in waste management, and how these roles are at least partly defined by the socio-spatial characteristics of the neighbourhood. For instance, the particular land uses of Tepito hinder the traditional waste collection system (*toque de campana*); yet an alternative collection system, which involves informal street sweepers, has been set up by the local residents to attend to these specificities of their neighbourhood.

Thus, the waste management system in Mexico City can be characterised as what Scheinberg et al call a "modernised mixture", that is to say, a diverse system where many service-

providers interact, including governmental and non-governmental actors, operating at different scales (Scheinberg et al., 2011). These actors operate at different stages of waste management, and the informal service providers particularly concentrate where the governmental infrastructure cannot operate adequately (because of physical and economic constraints). Looking at Mexico City in general, informal waste collection concentrates in those neighbourhoods where governmental trucks cannot operate (because of steep slopes, unpaved roads, or in the case of Tepito, semi-permanent structures which close off the streets); and informal waste management focuses on the accumulation and processing of recyclables, to make them economically viable to recycle in the formal recycling industry. In this sense, and similarly to Scheinberg et al's case studies, this "modernised mixture" where formal and informal systems operate in an interdependent fashion is what makes the whole system viable; and this happens despite institutional actors turning the blind eye to this interdependency. Even more, I would argue that these systems are almost indistinguishable on the ground. For instance, the "voluntary helpers" are an integral part of the team of garbage-men; they are usually friends or family members. They are dressed the same, do the same hours, share a beer after work. They are paid thanks to the whole team looking for recyclables and saving money for them. The only difference lies in their treatment on the part of the civil servants, who refuse to recognise them as legitimate waste handlers.

Finally, I looked at the spatiality of waste flows and show that the metabolism of recyclable waste is one that is inserted in a global network, unlike non-recyclable waste flows which are mainly handled within the metropolitan area (Figure 3.6 in Chapter 3 shows the main sites of waste recovery and disposal in and around Mexico City). Certain flows are relatively simple (with few intermediaries and a short distance between sites of generation and disposal): for instance, most non-recyclable and organic waste are handled by three intermediaries (waste collector, municipal transfer centre, disposal site) and are disposed of within the metropolitan area. This is also the case with most metals, which are smelted within the industrial areas of metropolitan Mexico City, and are used on-site to manufacture new objects (as illustrated in Vignette 3). Other flows are more complex - crossing national borders and relying on many traders acting as intermediaries: plastics particularly are mainly exported, and there are accounts of it reaching as far as China. The plastics recycling chain may depend on up to ten intermediaries (informal waste-pickers, recycling shops of different sizes, recyclables wholesaler, recycling industry).

By presenting this diversity of flows of domestic waste - and the actors who participate in them, this chapter challenges the government's portrayal of the waste management system.

Particularly, it shows the importance of informal waste handlers in managing waste. Yet, it still says little about their daily activities, working conditions, and decision-making processes: quantitative and spatial methods are limited to reflect on these issues. Also, it does not allow a reflection on the conceptualisation of informality: in this chapter, I use the concept of "informal" as a given but do not question the use of this term. The following chapter of the thesis uses qualitative approaches to gain an in-depth understanding of waste handlers' work, their perceptions about their own work (particularly in terms of working conditions and contribution to sustainability) - and the implications of their informal status.

Chapter 7

The everyday management of recyclable waste

This chapter looks at the management of recyclable waste by informal waste handlers. Telling the story of the day-to-day work of these workers is a way to explore the factors (such as their strategies and practices; norms, values and relationships) which influence the overall waste management system. While the previous chapter described the configuration Tepito's waste metabolism, this chapter aims to explore how this particular configuration is structured by the everyday practices of waste handlers.

This chapter focuses on the management of recyclable waste, and dives into the daily life of two groups of non-governmental waste handlers: first, informal waste-pickers; and second, workers of recycling shops. The section on informal waste-pickers is based on eight interviews and numerous informal chats with waste-pickers. The second section on recycling traders focuses on one recycling shop in particular, where I conducted a participant observation and multiple interviews; I also draw on complementary interviews to put some information in context. Building on these empirical accounts, the third and final section discusses how recycling is enabled by the generation of value throughout the recycling chain. Two factors play an important role in this creation of value: the symbolic role that waste plays in Tepito (as a means of charitable distribution of wealth), and the strategic use of knowledge and networks.

7.1 The daily lives of informal waste-pickers

7.1.1 What does a typical day for a waste-picker look like?

Waste-pickers are women, men and children who earn a living by picking through waste in order to find recoverable materials (this can objects that they can re-use, or that they can sell to recyclables wholesalers). They handle the great majority of recycling in Mexico City (the rest being handled by households who separate recyclables in their own home for later sale). The work of informal waste-pickers is difficult to describe because it differs in each individual case. It is an activity carried out by the most vulnerable, those who have no other way of making

a living (the homeless, drug-addicts, the disabled and elderly, ex-convicts). As a result, their way of working varies greatly: some work at night, others during the day; some work full-time, others as a complement to a precarious or low-paying job; some only work whenever necessary to afford a meal or their daily dose of drugs, while others need to make a living for themselves and their family, and thus work all day long however much they earn. Last but not least, some pick waste because they cannot do anything else, and others do it by choice.

Waste-picking entails picking materials that have a commercial value, separating them, cleaning them, and selling them to local recycling shops. Some waste-pickers work in the street, opening bags of domestic waste left on street corners, or picking materials from public trash cans (Vignette 3); others work within buildings, whether tenement houses, offices, malls or health centres (in this case, they would generally require an informal authorisation from the building administrator - or be employees within those buildings); some work along the municipal waste collection truck, picking waste at the same time that it is being collected (they are the voluntary helpers mentioned in the previous chapter and in Vignette 1).

They operate in virtually every neighbourhood of the city, and work at a very local scale: they usually work with a trolley at most (some only have bags that they carry on their back), and (at least in the case of Tepito) tend to operate on the same streets every day. This allows them to make important local contacts: households or businesses might periodically offer them some of their recyclable waste (for instance, one restaurant might keep all their bottles for one particular waste-picker), and they also get to know the other waste-pickers and their respective working territories.

As most waste-pickers are homeless or live in small, precarious or shared housing, they have no storage capacity for the materials they select.[1] Thus, they sell them throughout the day, either at the end of a day's work or various times during the day (this means they carry less weight on their backs while working). In the interviews, waste-pickers report to be earning around 100-500 pesos a day (6 - 30 USD); while the minimum wage is set at 73 pesos a day (4.4 USD).[2]

[1] Throughout my interviews, only one waste-picker, Benjamin, told me that he and his wife store materials in their flat for a few nights before selling them. This way, they accumulate more and can get a better price, he explains. Yet, this shapes their whole waste-picking strategy: they only pick materials that are very clean (to avoid rats and cockroaches being attracted to the flat) and that are light (as they have to carry them up two flights of stairs): mostly PET plastic bottles.

[2] This is what would happen on a typical day. On a particularly bad day or only a few hours worked, the daily earnings could lower to 50-80 pesos a day, while on a particularly good day (for instance, finding gold jewellery or other precious metals, it could reach 1000-2000 pesos.

7.1.2 What are some reasons to pick waste?

All the waste-pickers whom I interviewed and met during the fieldwork, were in some way marginalised from society. Some were drug addicts, others were homeless, some just got out of jail, others escaped an exploitative family, others were handicapped, or too old to work. In this sense, becoming a waste-picker is a way to make a living when a formal job is not an option.

Maria[3] became a waste-picker as a child. Escaping from her abusive parents, she arrived in Tepito alone when she was eight years old and lived in the street. She made a living by collecting organic waste and selling it to animal owners, who used it as feed. Over sixty years later, she is a great-grandmother, and still supports herself and some of her grandchildren and great-grandchildren by picking waste (although it is no longer organic waste, but rather plastics and metals now). For a while, she got married, moved to a house with her husband and stopped picking waste. Yet, as she explains:

"We were in love for five years and had children. Then I decided to come [back] here [in Tepito], and I left him there [in the house in the suburbs]. It's just that I wasn't, I didn't want to live .... how to explain... in the misery that he had me in. The kids would always ask me for things, but I know how to work. So I told him: 'You know what? Let me go! I know how to work, I know how to earn a living!' [...] It's just that I always loved making money, it's the vice I have [...]. If I want something I want to be able to get it for myself. [...] I wanted to live my life, I wanted to earn money, I didn't want to stay at home, not working." (Wh9, October 2015)

In Maria's case, although she started waste-picking out of need, she went back to it later in life as a choice, a way to be financially independent. She explains that she did not need money after she was married, but she wanted to earn her own. She always loved working, and although she tried many different formal jobs, waste-picking is what she was good at. It became a way for her to live on her own terms, to not depend on anybody, to be free.

Teresa, in her sixties, picks waste for similar reasons: although she lives with her mother in a different state, she comes to the capital for trips of a few weeks where she picks waste and saves some money, then goes back to her home town. As she puts it:

"Sometimes my mum says 'But they're giving me my money today [from the pension], I can support you.' And I say 'No, mother, they give this money to you, I have my own two feet, hands and eyes, so I can go and earn a living.' " (Wh10, October 2015)

These women portray their activity of waste-picking not as a consequence of a lack of alternatives (they could both be supported financially by their family). They put forward the

[3]Throughout this chapter, pseudonyms are used in order to preserve anonymity.

dignity and freedom that they earn while picking waste: they earn their own money by working for it, in a way that is morally respectable. The following extract exemplifies this point:
"We get by thanks to cardboard, tins and trash. We eat by gathering from the trash: if we didn't accumulate tins and cardboard, if we didn't get our hands dirty, well we wouldn't have anything to eat. We would be like those girls who have to get naked. Or to steal. No, we supply [our needs] thanks to iron; everything we find in the street means money for us. I have always told all those who are walking around, asking for one peso, two pesos, who ask money for their tacos - and it's not true, it's for their vice [drug consumption]. The money is here, thrown on the ground. If they don't pick it up, it's because they are lazy. [...] We the poor people we have to get by thanks to what is thrown away, what rich people discard - they drink a soda and then throw it away. But how can they say that one shouldn't throw it away in the trash, because this is what we get by on, this is how we eat. [...] We don't take this away from anybody, we just pick it up and sell it, in order to eat. [...] Although people say that we are disgusting and that we are pigs; we are poor, this is why we collect trash." (Wh10, October 2015)

As this extract shows, waste-picking requires hard work (one cannot be lazy, and one has to get their hands dirty), and for that reason it is money well deserved. Thus, one reason to be a waste-picker is the need to earn money and the willingness to do it in a dignified way: various interviewees mention, as in the previous extract, that they want to avoid the alternative (stealing, begging, prostitution). As Teresa puts it: "Even though I sleep in the street, I do not live a life of crime".

Yet, not all waste-pickers perceive themselves as having an alternative. One interviewee, Enrique, tells me he cannot get a formal job because of his criminal record, another because of his drug addiction. In these cases, waste-picking is the only alternative that these people see for themselves. In some cases, waste-picking is their only way to earn enough to survive and support their family: Benjamin has a full time job in a factory printing newspapers, however he picks waste in his free time with his wife, who suffers from epilepsy, and because of it cannot get a formal job (Wh18, October 2015). Others do it as a complement to their work (on weekends, as with the case of Luciano, who started waste-picking when his salary was just "not enough"; or like Miguel, a self-employed painter and electrician, who started to pick waste when he had no client on a given day or week).

7.1.3 Risks and physical health

I asked the waste-pickers I interviewed about the risks in their work; what seemed most dangerous to them. The homeless ones mentioned being attacked at night, and having their recyclables stolen while they sleep. Other mentioned conflicts with other waste-pickers, and competing over

the same materials, or working in the same street. The ones directly opening refuse bags mentioned insects and rat bites. Miguel is relatively new to waste-picking, and expresses concerns with the risks of cutting one's fingers:

"I have seen people [waste-pickers] who get dirty in the trash, they don't care if there are bits of glass or other things... and I think "Wow!" I'm not there yet: I mean, first I have a look, I look if there is a way to grab something, and if not, if I see that the situation is bad, that I have to get trash out of the bags, well I don't do it, not for one or two bottles. I mean, it's not even worth it, if I am going to get dirty! One has to prevent illnesses - because with the fingers, one can get cut, you'll see what happens to your finger! I guess some people have become immune to these things, because they've been doing this a while. And I mean, if you want to put your hands there, well it's your life, you know. I choose not to, I just take what's in sight. [...] For instance, there is trash on the street corner, and one can see: there are tins and bottles here, and from then on one might look deeper and deeper into the bag, but without digging or opening the bags, because the bags are closed, and then one might find sanitary pads, babies' nappies, I'm not doing it in a disgusting way." (Wh11, October 2015)

Once again in this extract, the idea of choice is put forward. Miguel refuses to puts his hands in closed plastic bags, he chooses his limits, even though it may reduce his profits. Others may choose to do it differently, which Miguel respects.

When I asked waste-pickers what they did if they got hurt, Enrique and others mentioned the public health facilities in the neighbourhood, where they can get free treatment in case of bites or cuts (Wh8, October 2015).

7.1.4 How are waste-pickers' relationship with other actors?

Because of the nature of their work, waste pickers spend most of their time in public and semi-public spaces, and so interact with many people on an everyday basis. And they have different relations with different groups of urban dwellers: between each other, waste-pickers generally do not interact much, explaining that there is competition between them, and it is thus better to each stick to one's own work. Besides, as some waste-pickers are drug addicts and may display violent behaviour, waste-pickers tend not to interact with other waste-pickers they meet in the street unless they already know them. At worst, they avoid them for fear of conflict (like Maria, who advised me: "It's not even worth interviewing them because they're always drunk"). At best, the relationship is a cordial one where waste-pickers know each other; but in no case did I witness waste-pickers work in teams (with the exception of Benjamin and his wife) - the relationship remains characterised by independence. Enrique is the interviewee who presented the warmest account of his relation to other waste-pickers:

"Interviewer: Could you tell me a bit more about other waste-pickers, do you generally get on well with them?

Enrique: Yes, yes, all the waste-pickers here know me, they kind of protect me, or they give me a bit of taco, or bread, or something. All the waste-pickers are kind of friendly to me.

Interviewer: And do you have an agreement about who works on which street, or maybe you work together somehow?

Enrique: No no no. I work on my own." (Wh8, October 2015)

Even if Enrique is on friendly terms with other waste-pickers, it does not mean to him that there is a possibility of working together.

Waste pickers seem to have good relations with the police, to whom they turn to for support. Indeed, various interviewees mention the police as having a key role in protecting them from assault, especially women. With regard to other governmental institutions, waste pickers mention the public health facilities along with the protection of the police, both of which they can access as any other citizen. However, none mentions any specific government structure (whether social services, environmental team, etc.) which helps them in their condition of waste-picker.

The most intricate and productive relationship is between waste-pickers and the residents of the neighbourhood they work in, which is generally based on solidarity. This is the story told here.

Waste-pickers' relationship with local residents. There are different ways to pick waste: the most dangerous of all is to directly open bags of domestic waste. These contain a variety of recyclable materials (plastics, paper, cans, glass), however they also contain the rest of the domestic refuse (organic waste, but also bathroom waste), most times all mixed up. Opening these bags is dangerous because one might come in contact with broken glass, syringes or blood, or faecal matter. These bags also accumulate in the street at night, which means that there are rats, cockroaches and other insects.

Waste pickers who want to avoid this work might look for people who separate waste for them. For instance, they could make an agreement with shop owners to pick up their waste. Shop owners might agree as this reduces the waste they produce (thus reducing the tip they give to the garbage-men), but also in order to help the waste picker make a living. Thus, some waste pickers have daily rounds, where they go to different shops and stalls to pick up particular waste (soft drink bottles in the restaurant, cardboard in the shoe stall, etc…) that somebody has kept in a separate bag for them (Vignette 2). Others offer to clean a shop or street stall, in exchange for a small tip and the ownership of the recyclable waste. Some waste pickers collect from

housing complexes, where the inhabitants might stock their recyclables outside for the waste-picker to collect. Others are employed as cleaning staff in commercial buildings, and pick waste during their work, as part of an agreement with their employer. For instance, school teachers may bring old textbooks to recycling shops when they have been replaced by most recent ones. These agreements between employee and employer, between neighbours, family members or even mere acquaintances, are key in providing waste-pickers a safer and more convenient way to gather recyclable waste. Approximately half of the waste-pickers I encountered during my fieldwork mentioned an agreement of that sort. Thus, most waste-pickers tend to say that the local community is helpful and supportive of their work, as many households and local workers separate the waste and offer it to them on a regular basis, which makes their job a lot safer (as the recyclables are not mixed up with hazardous materials) and efficient (as the waste-pickers can pick up big amounts of materials from one single place). As Luciano explains:

"Interviewer: So how do you pick waste? Do you walk around these streets?

Luciano: No, I don't walk around the streets or go to the dumps or anything like that. Instead, I go to the sports centres - those for which I already have the right to come by and to pick waste. I go to a gym where they also throw away quite a few water bottles, because they sell them there. I go to about six or seven tenements who know me since I was a kid - because I was born here, so a lot of people in those tenement houses know me. These people don't throw away [plastic bottles] to the trash, but they save them for me, they separate them for me, and I go every three days to pick them up. I have my exclusive places: where I go on Mondays, where I go on Tuesdays, where I go on Wednesdays... I don't go to the same everyday. If I want enough bottles to be there when I go, then I go every three days." (Wh12, October 2015)

When I asked him how he got the authorisation to pick waste in those sports centres, he told me the story of when he was once walking next to a sports centre, and when the cleaning employee saw he was picking bottles, he invited him to come in. Then, he took him to the centre's manager, and told him: "I am bringing you a man who will come to pick up our bottles." The manager agreed, and with both the manager and the cleaning employee giving him explicit permission to collect waste, then he feels that everything is in order and he now goes there regularly. Luciano gave me various examples of these agreements, and every single time, he emphasises that he was invited to come in and was offered the chance to pick waste - the first contact never came from him. Another example shows this even more clearly:

Luciano: "In this other sports centre, it was once again the young man who cleans. He saw me, 'hello, how are you', by the way, his name is Luciano too. One day, I tell him I went to the charity, I tell him this and that, and he says: 'well you should come here, because here we get

many bottles when there are football matches, right here.' So I tell him: 'So, can I come then?' and he says: 'yes. Even better, I'll gather them for you'. So now he leaves them for me.

Interviewer: and he doesn't want to sell them himself?

Luciano: No. Once I told him to, and he said: 'Ok, I'll try!', and he said he did, but it took him too much time. He said 'you come and do it'." (Wh12, October 2015)

In every story Luciano tells me, he makes sure to emphasise that he was offered this help, that people do not mind. Yet, this help is primordial to him. When he started getting old, he felt too weak to pick waste any more. But his neighbours started offering to do it for him, that he should not worry. Now, he says, "everybody helps me". Likewise, Benjamin tells me: "At night, sometimes people see us picking waste. They ask us what we do, and when we tell them, they give us some money. People are very noble. Like those who offer us their waste." (Wh18, October 2015). Although to different extents, the gratefulness of waste-pickers for the solidarity, friendliness and help of Tepito's residents was a recurrent theme in the interviews.

Waste-pickers' relationship with recycling shops. Waste-pickers do not have a mode of transport beyond walking, and most of them carry the recyclables on their back (or with a small trolley). Therefore, they tend to sell the recyclables to recycling shops that are close by. Location is thus a primary concern when deciding where to sell one's waste. However, this is not the only concern. Most waste-pickers try out various recycling shops and choose one which they like best. Then, they only go to that one. One could think that price is the main factor: waste-pickers would compare which recycling shop has better prices, and go there only. Indeed, this is an important factor to most waste-pickers. Yet, the main decision factor is respect. Waste-pickers look for a recycling shop where they feel respected. To them, that means that the workers treat them well (they say hello, thank you and good bye) and where they do not try to cheat them (some recycling shops have a reputation of having skewed scales). As Miguel explains:

"Interviewer: So you come to the recycling shop because you have a good relation with them?

Miguel: Rather, because they provide a good service. [They say] 'welcome', 'thanks for coming'... they don't do that anywhere else. Just: 'Weigh this here' and 'It's this much'. Nothing else. [...] Here, they treat everybody the same, there are no favourites. [...] Here, the lady tells me 'How have you been?', 'How are you?', 'It's good that you came, I'm glad'. Nowhere [else] do people talk to me like that." (Wh11, October 2015)

Miguel is a waste-picker who suffers from isolation in his community - and he fears that picking waste stigmatises him even more. Thus, it is all the more important to him that the workers of the recycling shop treat him well. The recycling shop where Miguel sells his re-

cyclables is the place where I conducted a participant observation - it is presented in the next section.

7.2 Practices and strategies of a small recycling shop

Small recycling shops are where informal waste-pickers and households sell the material they have selected. Their main activities have already been briefly described in Section 6.3.3; in this section I focus on the practices and strategies employed by the owners and workers of one of Tepito's recycling shops.

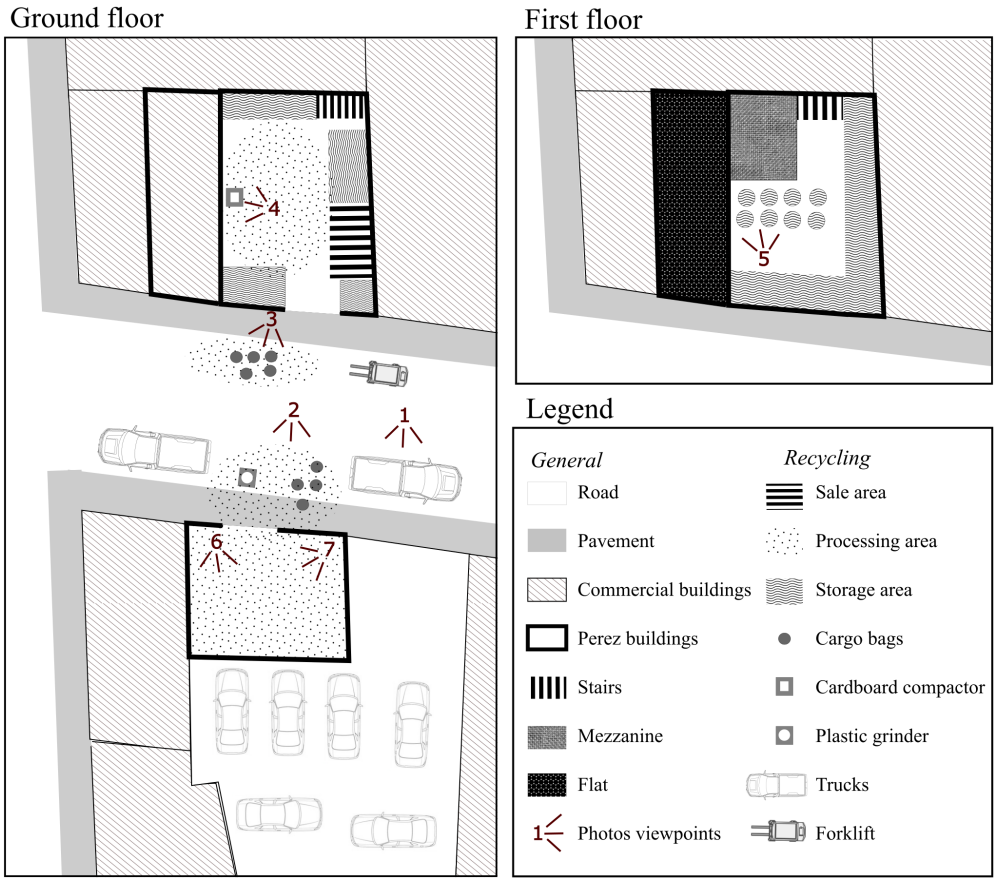
7.2.1 The Perez family and their recycling shop

The Perez family, a couple with three sons, owns one of Tepito's twelve recycling centres. Their shop is located in Tepito's residential area, in their 100m^2 warehouse, which is connected via stairs to their neighbouring first floor flat.

The recycling shop is five years old; before that, both Manuel and Sofía worked in a different sector (Manuel sold clothes, Sofía served breakfast and lunches to local residents in the warehouse). They started working with waste when they were both having trouble at their work: business was slowing down and they needed to earn more money, as their sons were getting close to starting university. A friend advised them to buy scrap metal, and that is how they started. At that point, they knew nothing about waste and recyclables processing.

Now, they employ six people (four men and two women, including Sofía's sister); and their business is growing, expanding beyond the walls of the warehouse - two years ago, the Perez rented premises on the other side of the road, nearly doubling their working space. Figure 7.1 is a floor plan of the two warehouses making up the recycling shop; they are separated by a street. The following photos present everyday sights from the warehouse, picturing the processing (Figures 7.2, 7.4, 7.5, 7.7, 7.8) and storage (Figures 7.3, 7.6) of recyclables.

Figure 7.1: The Perez's recycling shop seen from above



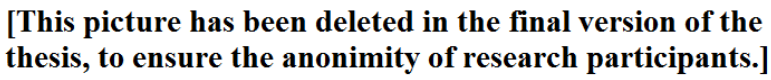
Source: Own drawing based on observations in Tepito, October 2015

Figure 7.2: View 1 (compacting metal in the truck)

[This picture has been deleted in the final version of the thesis, to ensure the anonimity of research participants.]

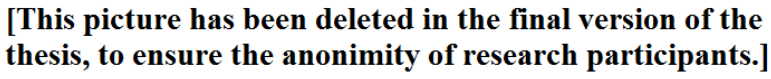
Source: Author's own, 2015

Figure 7.3: View 2 (entrance to the second warehouse, metal truck, plastic grinder and plastic bottles stored in containers)



Source: Author's own, 2015

Figure 7.4: View 3 (plastic bottles processing: cleaning, separating, and truck in the background)



Source: Author's own, 2015

Figure 7.5: View 4 (cardboard compactor)

Source: Author's own, 2015

Figure 7.6: View 5 (tins cans being stored, hanging from the warehouse ceiling)

Source: Author's own, 2015

Figure 7.7: View 6 (HDPE processing)

Source: Author's own, 2015

Figure 7.8: View 7 (e-waste and X-rays processing)

a.

b.

c.

Source: Author's own, 2015

Although activities change depending on what kinds of materials arrive in the warehouse, a typical day may look like this: the warehouse opens at 9 am and will remain open until 6 pm, with no break for lunch, from Monday to Saturday. Employees have a common meal after 6pm, provided by Manuel and Sofía and cooked by Sofía's mother, who lives down the street. The Perez buy most recyclable waste (except glass, because it breaks and causes injuries; and batteries, because they could not find a buyer), they process most of the waste before selling it, and they have gained a reputation in the neighbourhood to be the best-faring of all the local recycling shops. This means that they carry out all of the activities that recycling shops may carry out (buying, separating, cleaning, processing, accumulating, compacting and transporting/selling materials) and that their activity is constantly growing, which affords both Manuel and Sofía the possibility to think of their desires for the business' future.

7.2.2 Sofía's work: attending the waste-pickers

Sofía's role is to attend people coming to sell recyclables, in the sales area. She uses a table scale and a floor scale to weigh the materials, and pays the sellers in cash, based on the price of the material per kilo. This takes most of her day: at busy hours, waste-pickers queue up to be attended.

As Sofía handles the contact with waste-pickers and other sellers, an important part of her work is ensuring that the material brought by waste-pickers is of good quality. This means it has to be well separated and clean: paper, plastics and metals have to come in different bags, and no material has to come dirty; for instance, all plastic bottles have to be emptied. Sofía explains how she teaches waste-pickers how to separate materials (in this case, plastic bottles): *"I teach them, yes. What happens is that when we go to the companies [to sell recyclables] - my husband is the one who delivers to them. Then he comes back, and he tells me: 'You know what? They don't want this any more, they want that, they want it this way, separated, without a label, without the lid, they want it packaged...' and this way they buy it from us at a higher price. So I try to teach them, to the people who come here, all about how recycling is done..."* (Wh1, October 2015).

Another key information that Sofía passes on to waste-pickers is about which recyclables are bought or not, and at which price. Depending on the needs of the industry, recyclable wholesalers (Manuel and Sofía's buyers) change the list of the materials they buy, and their price from week to week. These prices depend, principally, on the exchange rate of the peso with the dollar (as recyclable materials are traded on international markets). When this happens, the information trickles down to Manuel, who tells Sofía, who in turn tells the waste-pickers: plastics will only be bought at two pesos from next week; or cardboard will drop below the

peso. Then, waste-pickers will focus their efforts on other materials - they might stop picking cardboard altogether. Alternatively, some may store it and wait until the price comes up to sell it - yet, very few waste-pickers have space to store materials.

As the recycling industry is innovating and evolving, their requirements change - and this information is shared with waste-pickers in the same way, through Sofía. In October of 2015, plastic recycling companies realised that something damaged their machines, particularly the PET plastic grinders. When they investigated it, they pinned it down to the machines being soiled by the cooking oil which remained in bottles. The remaining grease in the bottle stuck to the grinder's parts. Thus, they decided to stop buying oil bottles. For the wholesaler, this meant that the PET plastic material that they sold to the recycling industry had to be free of oil bottles. They told Manuel this new rule, who told it to Sofía. Sofía's task was thus, in the following days, to inform each person coming to their shop, that the plastic they came to sell had to be free of oil bottles. This happened during the course of my one-month main observation, and within a few weeks, I observed how most waste-pickers had indeed stopped collecting oil bottles; and the bottles rarely appeared in the PET plastic material by the end of the month.

Yet, the fact that most waste-pickers complied with the new rule is not enough: when Manuel goes to sell its plastic to the wholesaler, the quality of the material is thoroughly checked, and if the acceptable standards are not met, Manuel is at risk of losing his buyer. This is why the role of the employees of the warehouse, in charge of cleaning and processing the waste, is primordial.

7.2.3 The employees' work: processing the recyclables

The Perez employ four male employees. Julio has been there the longest: he used to be a waste-picker but finds this work to be more stable and with a fixed income. Besides, he enjoys working during the day with fixed hours, as he just had a daughter and wants to spend time with her. Salvador and Francisco are in their fifties and sixties respectively; they were both in need of a job and could not find anything else - they are very grateful that Manuel hired them when they asked for work. Gerardo finally, does not work full time: he is a young professional wrestler and wants to live off his craft. Yet, he comes by a few days a week to complement his income. His help is always very much appreciated because of his physical strength, and he usually takes care of the more demanding tasks.

Once the materials are bought by Sofía, they are taken away by one of them to the processing area. Cardboard is taken to the compactor to be compacted and made into 300kg bales (see Figure 7.5); plastic bottles are taken to the street, where they are checked (for instance, this

is where the remaining oil bottles are removed), separated by colours and their labels are taken off (see Figure 7.4). Paper is separated by colour and stored.

Metal may be bought either as a single material (for instance, lead pipes or tin cans), or embedded in a wider product, usually furniture or appliances. These have to be broken down: the metal within the product has to be retrieved, and the rest of the product is thrown away. For instance, a fridge will be broken down in order to retrieve the metal sheets within the walls of the fridge; the rest is thrown away. This activity takes place in the street by the metal truck. The fridge is broken down by one of the employees with an axe. Then, a forklift is used to lift the metal pieces to the truck (see Figure 7.2). Gerardo tends to do most of the heavy work that breaking down and carrying metal requires; the other three employees share the remaining tasks as needed.

The two female employees are usually in the second warehouse, where they attend tasks which require less physical force. Both Josefina and Guadalupe live in the neighbourhood and work full time in the recycling shop. Josefina is Sofía's sister; after her husband died, she needed to work to support herself. She moved from another city to Tepito to live with her mother and work with her sister. Guadalupe also arrived after her husband died a few months beforehand. She and her husband owned a nearby car repair shop, but Guadalupe did not feel she could handle it alone after her husband's passing. She now works in the recycling shop as a temporary job; she hopes to find a more formal employment where she could be enrolled in a pension scheme.

The activity that takes most of Josefina and Guadalupe's time (all day, most days of the week) is processing high-density polyethylene (HDPE) (see Figure 7.7). HDPE is a rigid plastic material used to produce everyday items such as toys, buckets or plastic plates. But the HDPE processing described here only applies to opaque plastic bottles (used for shampoo, washing liquids, milk, etc.). Manuel has found a buyer for HDPE material; yet, the buyer requires the HDPE to be ground. This requires the following tasks (illustrated in Figure 7.7). After HDPE is received (picture a.), all labels and taps have to be taken off the bottles using a cutter (picture b.). The bottles have to be emptied and separated by colour (picture c.). When this is done, Julio, one of the employees, comes to pick up the cargo bags full of processed bottles, and takes them to the plastic grinder (Figure 7.3), where he transforms the bottles in plastic chips (picture d.). Julio has been there the longest of all employees; and as such he is the only one allowed to operate the machines (the cardboard compactor and the plastic grinder). The HDPE chips are then packed into bags (picture e.) and loaded in the truck (picture f.), ready to be sold.

7.2.4 Manuel's work: selling the recyclables and running the business

Selling the recyclables. Manuel is the only one who drives the delivery trucks: his most time-consuming activity is to transport the processed recyclables to his buyers (either recyclable wholesalers, or sometimes directly to a recycling company). He usually drives to the industrial zone in the northern area of Mexico City; between five and ten kilometres away. Each material has a different buyer, and is sold on a separate trip. Materials are only sent to be sold when a truck can be completely filled: this is to minimise the number of trips, and therefore, the cost of gasoline. There is another reason to avoid unnecessary trips; which is the potential encounter with ill-intentioned policemen. Manuel explained to me that he is prone to extortion when he drives around with his trucks. Firstly, not all his trucks have the proper environmental label (which proves that one's car has been examined and its emissions of toxic particles have been checked) - this, Manuel says, is because the trucks are too big to enter the examination centres. Then, Manuel sometimes uses his trucks on the day they are not allowed to be used (there is a system of alternating circulation in Mexico City) - Manuel says he does not have a choice: when his trucks are full, they have to be emptied, as they act as the main storage space for metals and plastics. If Manuel waited just one day to empty the truck, his whole business would have to stop for a day. Then, sometimes the truck is stopped by a policeman for no reason at all; just in the hope that by stopping Manuel long enough, he will agree to pay a bribe to be let go.

Polyethylene terephthalate (PET) plastics is the material that is most often sold, principally because of its bulkiness: every two or three days, the truck containing one ton of bottles fills up and needs to be emptied. The metal truck fills every week with three to four tons of metal; and the HDPE plastic truck may fill with 300 kgs each week. PET bottles, HDPE plastic and metal each have a dedicated truck (seen in Figure 7.2, Figure 7.4 and Figure 7.7 c.), which is parked in the street, and is filled incrementally. The trucks thus serve as storage as well, in order to save space in the warehouse. The rest of the materials (non-PET plastic, tin, precious metals and paper) are stored in the warehouse until they are to be sold, which can take from a few weeks (for paper) to up to a year (for precious metals such as copper). Then, Manuel uses one of his two pick-up trucks, parked in the nearby public parking space, and fills them with whichever material he wants to sell that day. The quantities of materials are presented in Table 7.1 and show that paper is the material that is most sold in terms of weight. Plastic only represents seventeen percent of the total, but bearing in mind it is less dense, it still represents (in terms of volume) a major material in terms of the business' activities.

Table 7.1: Estimate of materials handled in the Perez recycling shop, on average in one week

Material	Quantity (kg/week)	Percentage of total
Plastic	**2,660**	**17.36**
PET	2,000	13.05
Green PET, HDPE, hard plastic	280	1.83
Low Density PolyEthilene	130	0.85
Polycarbonate	250	1.63
Cellulose	**6,600**	**43.08**
Cardboard	3,600	23.50
White paper	1,000	6.53
Color paper	2,000	13.05
Metal	**6,060**	**39.56**
Aluminium	2,240	14.62
Tin / Steel	250	1.63
Mixed Iron	1,500	9.79
Heavy iron	2,000	13.05
Copper	19	0.12
Bronze	48	0.31
Silver	<1	0.01
Lead	<1	0.01
Antimony	<1	0.01
Total	**15,320**	**100**

Source: Based on own observations in Tepito, November 2015

Ensuring the security of the business. Part of Manuel's work is ensuring that the business is safe - particularly safe from the government. Indeed, the Perez are constrained by extortion and fear of the police. The business is registered with the government tax office, which makes it officially a "formal" business (that is, part of the formal economy). Employees work full-time on a regular basis, have fixed wages, and have days off. However, despite paying taxes and thus being a "formal" business, the relation between the recycling shop and the government is characterised by informal relations. The most visible civil servant around the warehouse is the policeman, who rounds daily in the street. He has been hired by the business owners of the whole street, to only stay in this street in order to protect them from robberies and assaults, and thus comes weekly to collect his "pay". Then, there is the extortion by municipal employees, on the grounds of not complying with particular rules. This happens in the recycling shop, in the municipal offices when the Perez go to process paperwork; and on the roads when the materials are driven to be sold. Manuel always has a bit of cash with him to pay off policemen. When I ask Sofía whether she gets any support from government, she answers that this is not the case, the government is only a source of fear and extortion. Whether it is to renew her licences, pay her taxes, or any other bureaucratic activity, interactions with civil servants are always characterised by having to hand in money in order to be received, submit paperwork

or be given any information. As Sofia explains, civil servants use different strategies to extort money from her (in this case, their use of part of the street to process materials):

"Yes, I run a formal business, I print invoices [for tax purposes] and everything. But they claim it's because of the road traffic we cause. But in Tepito it's always like this anyway! You can never drive properly through the street! This is a commercial zone. What I mean is, wherever you go in Tepito, there are places where it's difficult to drive through... and actually, we let traffic circulate, and pedestrians as well. We always do our best effort for people to be able to circulate, on each side of the road. [...] the government is very nasty, honestly. It doesn't help you, doesn't support you. They say they help small businesses... the only thing they did is make us register [with the tax office], to stop playing dumb and make us pay our taxes... But nothing else."

Other examples that Sofía describes are the renewal of the annual business license, the trucks being parked on the street, and the lack of safety procedures in case of fire - every one of them having been resolved through bribes. Manuel agrees, explaining that although he does not like engaging in corruption, it is the only way to keep the business running. Indeed, based on my observations in the neighbourhood, this seems to be the opinion of many (if not most) small business owners, whether registered with the tax office or not. The relationship with the authorities is characterised by ongoing negotiations as to the right to work, and in which circumstances. As far as environmental and sustainability aspects are concerned, the Perez have never received the visit, or had any sort of contact, with any civil servants in charge of waste management or sustainability strategies.

Manuel as a "todologo". Manuel has other duties in the business: he is the person who repairs the machines, and generally attends any unforeseen problem in the recycling shop. This has led Manuel to call himself a "todologo", expression literally translated as "everything-ologist". As Manuel explains to me, this is an expression that might be used pejoratively,[4] however, in Mexican middle and lower class at least, this term is used to describe someone who knows "a bit of everything" and mainly, who is not afraid to try. It means one will not rely on a professional but will try to do something on his own. Typically, one uses this phrase to describe someone who fixes their own home – learning about electricity, plumbing, etc. in the process – rather than calling for help. In the case of Manuel, this takes place in his professional life: he learns as he goes along. As he himself puts it:

[4]In the main Spanish dictionary, the Real Academia Española, the definition of *todólogo* is: "[derogatory, informal.] Person who thinks they know and have good command of various specialities." (Real Academia Española, 2014, own translation)

"The ingenuity of the Mexican is always something that doesn't look good. [...] We have disassembled this whole machine [showing me the cardboard compactor]. Without knowing. And we have fixed it. Maybe not like in the USA, where one has to have a certificate, and that everything is perfect... It's the same with the electricity: maybe you see all the cables over there [shows me a bunch of cables hanging from the ceiling] and you think: 'It doesn't look good'. But it is because we changed the whole business here [meaning, from a food kitchen to a recycling warehouse]. So... we had to improvise! As the business grows, well we will fix it. But I'm Mexican: so I learnt about electricity. And now I know how to cut, how to weld. Now we are learning how to process [recyclables]... so here, we are all todólogos." (Wh2, October 2015)

During my observations in the recycling shop, I witnessed Manuel repairing the cardboard compactor, which he mentions in this extract. The machine runs on diesel, and there was a leak in the diesel tank. Instead of calling for help, Manuel decided to take the opportunity to teach his son, Arturo, how to weld. So they turned off the machine, and started welding. It took hours, and had to be re-done various times throughout the month, as the repair was not well done. This meant that it was difficult to work around the repairs to compact the cardboard, which accumulated in the warehouse. Yet at the end of the month, Manuel's son knew more about welding and the machine was repaired.

This is not the only story of the cardboard compactor: this was the first machine Manuel bought, one of the first investments for the recycling shop (after the metal truck). At this point, Manuel could not afford to buy a new machine. So he decided to ask for help from his neighbours, who own a car repair shop. The neighbours go regularly to the US, and visit *yonques* (car pounds / tow yards), to buy cheap car parts. Then they drive back to Mexico and use the merchandise to repair cars cheaply in Tepito. Manuel decided to join on one of those trips, and visited industrial waste sites - there, he found the broken compactor. The compactor was already dismantled, ready to be disposed of and recycled. Manuel bought it as is, brought it back to Mexico, and assembled it, fixed it and learnt how to use it by himself.

While I was carrying out my observation, Manuel's youngest son, Alex, was also sent to the US with some neighbours to visit industrial waste sites - he was sent not to buy anything, but to learn: he came back to Mexico with a proposal for a machine to buy, and a price he had negotiated with its owner.

Manuel thus spends time trying to acquire new knowledge, and he learns by doing. He learns about his machines by himself; and he also spends time talking to his buyers (the recycling warehouses) to learn more about the recycling business. It is by talking to different

wholesalers that he understood that the more recyclables are processed, the higher their buying price. This is when he decided to invest more resources in processing his materials - and his recycling business took off.

For instance, he bought the plastic grinder in order to produce HDPE plastic granules. Before that, he sold the HDPE bottles at a very low price. He learnt about how the industry required the granules to be (clean, separated by colours, etc.) and produced a few hundred kilos of each type of granules. Then, he brought his granules to different wholesalers to bargain a new price for his HDPE material. Sometimes, his experiments work and he manages to get a higher price; other times, Manuel does not find a buyer - high up in the warehouse, hidden from view, is a shelf of these failed experiments: bags of plastic granules, cut up papers and other attempts at processing materials which have not yet found a buyer. But they are kept as a showcase for potential new clients.

7.2.5 The engineer: innovation for waste processing

About a year ago, Manuel came to a standstill with his innovations: he realised he required more technical knowledge. As he puts it: "I don't know everything!" His decision was to hire a consultant, Martín, a retired engineer. Since his retirement, Martín has been providing consultancy services to both the recycling industry and small recycling shops such as the Perez's.

Manuel and Martín struck a deal where Martín would work in the recycling shop for a few months, and help Manuel boost the business' profits through implementing materials processing. As Manuel explains:

"A lot of people only do the basic tasks, because they don't have money or time to invest. We have the capacity to invest, and sometimes the environment is more or less favourable in this difficult economy, well somebody has to do it, and we have this opportunity... but yes, it is difficult to find someone to teach you. I'll tell you, the engineer charges fees - and believe me, they are not small fees! - and he has certain privileges: he doesn't work physically, it's not his job, his job is to teach us to process." (Wh2, October 2015)

In this extract, Manuel stresses that Martín's privileges (which include setting his own wage and working hours) are justified: as an engineer, Martín holds technical knowledge about recycling which very few people are willing to share. Sofía adds that Martín's help is also valuable because of his numerous contacts: "He takes us to better companies, and he helps us get a better price" - when prompted about Martín, Sofía merely says: "he knows a lot of things!"

In our discussions, in which the Perez often took part, Martín's way of presenting his work often reinforced his position as someone holding a monopoly of technical knowledge, which is both indispensable and unknown to most waste workers. As in the following extract:

"Like the other day, this radioactive material got to the recycling shop. This is very dangerous, and if they go to sell a truckload of metal with this in the truck, they will turn down the whole truckload and it would all have to be thrown away. But a lot of people cannot recognise radioactive material..." (Wh6, November 2015)

This monopoly over technical knowledge has affected the power relations between the Perez and Martín. This point will be taken forward in a later section. Before that, let us look at three processing projects Martín has been helping Manuel with.

Photographic films. Photographic film contains small amounts of silver. In Tepito, photographic film is commonly used for two purposes: medical X-rays, and negative images used in the production of pirate CD and DVD sleeves. Martín's first activity at the recycling shop was to develop the recovery of the silver contained in photographic film. He assures me he uses a very ecological, harmless process: although in the industry, chemicals are used, he uses only caustic products and common salt. This activity takes place in the second warehouse, with the help of Josefina and Guadalupe (see Figure 7.8). First, the films have to be immersed in a liquid containing chemicals and salts, during various days (picture c). The liquid is then filtered: the water is removed and what is left is a sort of chemical mud. This mud is heated on a cooker (picture b.) until the liquid is evaporated. Once it cools down, the product is a dust composed of pure silver mixed with bits of plastics and salt. Josefina and Guadalupe's work is to separate these fine particles using their hands, to recover the silver. When she sees me observing, Guadalupe apologises for not wearing gloves. She explains that although Martín told them it was very important to wear gloves for this operation (as some particles are toxic), she never uses the gloves because the work is so fine it can only be done with bare hands. Thus, despite Martín's claims of the process being harmless, it appears that both Guadalupe and Josefina exposed their skins to the caustic residues.

In a few weeks, the Perez managed to buy 250kg of photographic films and recovered 5kg of silver.

E-waste. Martín's current project is the recovery of the small amounts of gold and palladium embedded in common domestic appliances (for instance TVs, DVD and CD players or desktop computers) (see Figure 7.8 a.). As Martín explains:

"The industry does it in a very dangerous way, because they use acids and cyanide. Our process is more ecological. What we do here is to change the PH level, to separate the elements. First you precipitate the gold, and then the palladium. Then you add salt - the iodine we use for this process is metallic iodine, and we re-use it. That's why it's ecological. Well actually, we could even throw it in the drainage, because it can be used to clean the drainage, so actually

it is un-polluting. So we do it better than in the industry. We have to be careful to not affect the neighbours, the environment, the employees... it may be more expensive, and a bit more difficult, but it is important to do it right. (Wh6, November 2015)

The Perez have not yet fully recovered gold or palladium out of this process, but they estimate to be in the last stages of the process.

PET plastic granules. When I started the fieldwork, the Perez would buy PET bottles for three pesos, and sell them for about four or five pesos per kilo. However, their buyer was being more demanding each time: the colour had to be further separated, the labels had to be taken off, some of the taps as well. This required many hours of labour for little profit. Thus, the Perez decided to invest in processing PET in order to increase the added value of their product. Martín advised to make granules of PET plastics. The process is similar to that of HDPE, but it is a bit more complex as it requires cleaning and drying the bottles before grinding them. It is thus necessary to buy a plastic grinder, washing machine, and dryer. First, the PET is ground, then it is washed with chemicals to remove the sugar and the glue on the bottles, and then a dryer removes the remaining water and chemicals. The product obtained is of much higher quality, and can be sold directly to factories that use plastics as inputs (rather than to recyclable wholesalers); thus selling it as a higher price. As of the moment of fieldwork, this project was in the planning stages, and had not been started.

Latest developments. I came by to visit the Perez in March 2016, a few months after the main participant observation took place. I congratulated them on the brand new plastic washer and dryer I could see in the second warehouse. Yet their reply was quite grim. Sofía told me that Martín had not been coming for a while - he received the pay for the machines and bought half of them (the grinder still being missing) but had not installed them or taught the Perez how to use them. Particularly, he had not shared the chemical recipe necessary to clean the PET bottles properly. Sofía added that she felt betrayed, that Martín took the money but never finished the job. Worse, he never fully shared the techniques of the e-waste and photographic films. "It's a problem, said Sofía, we asked him to teach our son, so that we can manage when he leaves... but no, he is making himself indispensable. [...] All he is interested in is the money" (Wh1, March 2016). This episode, and particularly Sofía's feeling of helplessness when Martín disappears, shows the importance of knowledge in innovation, whether acquired through experience (as Manuel has done for the HDPE processing) or through formal studies. Yet, the difference between these two knowledges is how they are acquired and shared. This is the focus of the discussion in Section 7.3.2.

7.2.6 The recycling shop as providing a community service.

Manuel and Sofía have plans: they want to grow their business, to be able to retire, and to leave a functioning business for their sons. This is why all three sons come to work from time to time, generally during university holidays, so that they can learn more about the business, and maybe run it someday. In order to grow, the main thing the Perez would need is a bigger workspace: their activity is constrained by the walls of their small warehouses. They dream of bigger premises in an industrial zone, where they could process plastics and metals in a more efficient way; which would allow better profits. Yet, Manuel tells me, even if that were to happen, they would not abandon their current warehouse. One of Manuel's motivations is to be a part of his community, the place where he grew up. Through his work developing the recycling shop, he feels like he is working towards improving his neighbourhood: by buying recyclables from waste-pickers and households, he contributes to cleaning the streets. But perhaps most importantly, he provides a way for his neighbours to earn a living. Whether as a main source of income for the waste-pickers; an extra for many housewives, or pocket money for the kids, Manuel values the possibility that his work gives him, to re-distribute wealth across Tepito's residents, who direly need it. Sofia agrees, and this is reflected in her work: attending waste-pickers, weighing their materials and checking their quality is a time consuming activity; this is why most recycling shops who can afford it, set a lower weight limit to buy recyclables (usually a kilo). Although this would make Sofia's work easier, she has decided not to set a lower weight limit; as this would mean that many households would have to stop collecting recyclables altogether (keeping plastic bottles at home until one kilo is reached for instance, requires a large storing space). In addition, sometimes a few hundred grams of material is all someone has, but selling it can mean he gets to buy lunch for that day. Thus Sofía never refuses to buy materials on the ground that the small amounts are not worth it - another reason is that it is also good for her business. As she puts it: "some people bring me two hundred grams, three hundred grams, and that is acceptable as well, because that's how you make kilos!" (Wh1, October 2015).

7.3 The creation of value in informal recycling

7.3.1 Finding value in waste

The last chapter showed that very early in the waste management chain, waste flows are separated in two: non-recyclable waste flows on the one hand, and recyclables on the other, are handled separately. Two distinct groups engage in these activities: while municipal employees manage the non-recyclable waste flows, informal actors engage in recycling. Why this sepa-

ration? I argue that different groups engage in different activities based on their perception of waste, and more particularly, on the value they attribute to it. For municipal workers and street sweepers, waste is an unwanted object to get rid of, a nuisance which accumulates and has to be disposed of: their role is to keep the streets clean, and waste has to be taken as fast as possible away from the neighbourhood. For waste-pickers and recycling shops on the other hand, waste has value, and the more one engages with waste, the more value it holds.

Chachara. The fact that waste-pickers attribute a particular value to what others consider waste is reflected in their use of the word "chachara", as in the following extract:

"What I think is, let them keep throwing away trash, because this is where poor people earn their living. We go and pick it up. We find a chacharita*, and we earn ten or twenty pesos, it's enough for the tortillas [colloquial way to say it's enough for the basic food supply]. They throw away a pair of shoes, they're still good, well if they fit, we'll use them. This is how we survive. [...] Can you imagine? Can you imagine, if they didn't throw away trash, how would we survive? [...] If they don't want to give us money, it's enough if they throw away trash. Don't you think?"* (Wh10, October 2015)

The term "chachara" can be translated as "trinket", some object of little value (Mejía Prieto, 2002). It is a Mexican term used commonly in daily life: a *chachara* is an object that was thrown away by someone, because it has no value - it is trash. "In Mexico and Chile, to be a *chacharero* is to collect useless things" (Alatorre, 2001, own translation). Yet, the action of collecting reflects the value given to the object by the collector: this value can be emotional, monetary, or even artistic.[5] This word *chacharita* (referring to a small chachara), when used by Teresa, reflects this differential of monetary value perceived by the person who throws away versus the person who collects bits of waste. Teresa picks up *chachara*, objects that have no value for their former user and who decided to throw them away. However, for a waste-picker, these objects have monetary value which is created through two means: the knowledge accumulated by the waste-picker (she knows which objects have value, and where they can be sold), and the time dedicated to picking waste. To take an example: a few used food tin cans have no value for a middle-class person who does not know (a) that tin is recyclable, (b) that there are recycling shops buying tins from households, and (c) where these shops are. Besides, a few

[5]One example of an artistic use of waste comes from an interview I conducted before working in Tepito, with a sculptor. He would visit industrial deposits, looking for bits of metals to use in his sculptures. They were pieces of broken machinery, lying in the industrial deposit waiting to be smelted. However for this sculptor, these pieces had an artistic value; they inspired him to create new pieces. Thus, the *chachara* does not have *immediate* monetary value, as the sculptor has to use his expertise and creativity before that piece of metal can gain monetary value. Another example is the pieces sold at a flea market. People might buy antique furniture, household objects or clothes, not for their monetary value but rather because they find another source of interest in them (aesthetics for instance).

tins would sell - at most - for a few pesos, which is a fraction of what this person would earn in an hour's work. Even if this person separated and sold all the recyclables thrown away in his home, the money earned would be so minimal compared to their income, that it is not worth the effort. On the contrary, for a waste-picker, a few pesos is already a lot (enough to eat) - and the more time is spent waste-picking, the more viable it becomes. Most of all, it is a constant source of income. This example shows how the same piece of trash - a *chachara* - can have a different value to different people; and it is the value that waste-pickers attribute to recyclable materials that ultimately define them as a distinct group within the waste workers - groups, for instance, to which the municipal waste workers do not belong.

Waste as a way to distribute wealth. The *pepena* activity plays another crucial role in Tepito: that of distributing wealth among the neighbourhood residents. Earlier in this chapter, the notion that dignity comes from earning one's own money was already touched upon. This idea is particularly deeply entrenched in Tepito: one recurrent saying in the neighbourhood is "En Tepito siempre hay para comer" - in Tepito, there is always something one can do in order to eat, there are enough odd jobs going around. Many people consider beggars to be "lazy", to choose not to work. Thus in Tepito, when one wants to help a destitute person, they would offer them a bit of work in exchange for some money - rather than just giving them money. This could be help with sweeping, carrying groceries or cleaning, among others.

Waste-related activities (sweeping, cleaning, throwing away garbage) are among the most common activities that people carry out in exchange for a bit of money. For instance, Maria explains:

"I have to pick all kinds of waste to survive... and we have everything we need. And besides, as I tell you, I also sweep street stalls, I offer my services with waste - well, I don't even need to offer my services any more. They know me by now, and they tell me: 'ma'm, go throw away this trash' and I say 'Yes, of course', and they give me a bit of change." (Wh9, October 2015).

Commonly, these services are accepted by the street stall workers in order to help out the person who offers - at least as much as because the help is really needed. The relationship between Luciano, the waste-picker, and his neighbours, who separate waste for him, can also be seen in this light: the neighbours choose to separate their waste in order to provide Luciano with the means for his livelihood. It is a way to ensure Luciano can survive and have a bit of money to provide for his needs, without harming his dignity by offering him charity.[6] If they

[6]When I planned my interviews with the waste-pickers, I had decided to offer them money for their time: they would have to take some time away from waste-picking to sit down with me and answer my questions, so that seemed fair for me to pay them. Yet, all but one waste-picker refused the money. Some were offended by the mere fact that I would offer.

were to offer Luciano money, he would probably refuse; but waste is different, as it is generally accepted that it is useless to those who produce it - Luciano is not taking anything away from them, he is, rather, providing them with a service of waste removal. It is thus by some sort of implicit convention, unspoken but known by all the neighbourhood residents (and I would argue, beyond the neighbourhood) that offering waste is not a charity act but the offer of a dignified livelihood.

This also explains the numerous informal agreements between buildings' cleaning staff and their employer: the latter turn the blind eye to the fact that the former separate recyclable waste during their working hours, to earn a bit of extra money; they also refrain from appropriating this recyclable waste for themselves or for the company. It is a way for the employer to help their employee increase their income, but through their own work.

Thus, waste does not only have a monetary value (derived from recycling through the work of waste-pickers); it also holds a symbolic value which allows it to play a role in wealth distribution in the neighbourhood: while most destitute people would refuse charity, and want to earn their living through work in order to preserve their dignity, waste is symbolically accepted as a product of such little value that it can be offered without it being considered charity - and it is through the waste-pickers' time, efforts and knowledge that the monetary value of waste is created.

The Perez' work ethics is another example of waste being viewed as having a community value. Manuel and Sofia think that one way to grow their business would be to move away from Tepito: this would allow them to get a bigger warehouse, which means they would have the space to process more waste. They could also choose a strategic location in an industrial zone, which would increase their likelihood of receiving commercial and industrial waste (which comes in bigger quantities, and generally cleaner). In short, they would like to become recycling wholesalers. Yet, despite this being the correct business decision in their eyes, they decide that it is more important to them to remain in Tepito. They both value the fact that their activity in Tepito enables them to share their income with local residents - rather, the value that they are creating is necessarily a community-shared value, as the basic input is produced daily by the residents.

The value of waste is thus constructed through the work of residents, waste-pickers, and workers of the recycling shop who transform waste into recyclable material, as well as through the symbolic value that is attributed to waste as a means to provide a livelihood to the neighbourhood's most destitute people and which provides a reason for so many actors (beyond personal economic gain) to participate in this activity.

7.3.2 Creating value from waste: the role of knowledge

The role of knowledge in recycling. I have argued that it is through waste handlers' time and effort - that is to say, through their work - that value is produced out of trash. In this section, I argue that knowledge is waste handlers' primordial asset, the decisive factor in the production of value.

A case in point is the example of the Perez. The last section has shown how knowledge plays a key role in the business faring so well. The Perez are arguably poor in terms of any asset that contributes to the success of a business: when they started five years ago, they had very little money to invest (and no chance of getting a formal loan), no employees, no machines, very little space (they only had one warehouse, and it was set up to run a kitchen), and no knowledge of recycling whatsoever. They have gained assets of all these types to some extent, yet the business decisions they made always favoured the investment in knowledge and learning above all other options.

Instead of buying expensive machines, Manuel decided to take a chance buying broken, second-hand ones, and learnt to repair them himself. More generally, Manuel spends most of his time in search of new knowledge he can use in his business: when he goes to sell materials to wholesalers, he takes the opportunity to ask them more about their business, and their requirements. This allows Manuel to learn about how to process materials in a way which is attractive to wholesalers.

Manuel's involvement of his sons in the business is also a testament to his interest in knowledge: he asks his sons to work in the business, yet they are not used as free labour: they only carry out tasks where they can learn. Manuel teaches them to repair the trucks, the machinery (such as when Arturo learnt to weld on the compactor), but also to become good managers. This is why Alex was sent to the United States to negotiate prices of machines. Manuel encouraged two of his sons to study engineering, so that one day they could use what they learnt at university to keep improving the business' techniques.

Until this day comes, this task is up to Martín, the engineer. The use of his expert knowledge in the implementation of recycling processes in the warehouses has been crucial in increasing the business' profits. The ambiguous status of Martín with regards to Manuel and Sofía also reflects the importance of knowledge for the business: because Martín is the sole person with access to expert knowledge (and the capacity to apply it), he is granted a special status, where he earns more than all other employees (and, I would suspect, than the Perez themselves) and is allowed to challenge the Perez's authority and rules (for instance, by setting his own work hours, or by not showing up for days on end).

Manuel and Sofia are not the only ones identifying knowledge as the key to recycling shops' success: Don Salvador, a waste-picker and owner of a small recycling shop (with no employees but himself), shares their view. According to him, two main assets contribute to the success of a business: knowledge and money. Yet, it becomes clear that knowledge is more important than money in Don Salvador's opinion, from the following extract:

"Don Salvador: There is a young guy who used to have a tremendous recycling shop over there, it was over four times the size of this plot - very big. He worked in government, and invested his money, up to ten thousand pesos[7] *when he got paid, but the business didn't grow. So, what's the point of all this? He would buy huge quantities of material. Why? Well firstly, this man didn't really know what he was doing. He had to come and ask me for advice: 'How do I do this? Salvador, what about the clothes hangers, how do I separate them?' Because the clothes hangers, you have to take out the styrene, you have to clean it up really well, and separate the white, the black, the blue, the red... The clothes hanger is very difficult to work on, because it's made out of different materials. The clothes hanger... I know where to buy up to a ton of clothes hangers. Once, I filled up my warehouse with clothes hangers, and yes, as I was telling you, I know a lot of people. So this guy comes to ask me for advice, he had employees, and a truck, he had everything, but no no no, you wouldn't see any progress. Do you know why?*

Interviewer: Because he didn't know the ropes...?

Don Salvador: That's right, because he didn't know the ropes! If I had had his work, and with my knowledge... We would have bought up the entire block, we would have rented them, and started to grow. This could have been done in two months..." (Wh20, November 2015)

In this extract, Don Salvador emphasises the idea that without the right knowledge, one cannot succeed in this business: this young man bought huge quantities of material, yet he did not have the required knowledge to process it properly, nor the required contacts to know who to sell the material to. Don Salvador goes on by explaining all the things that are difficult about processing the clothes hangers, highlighting the knowledge he himself has. Yet, despite his expertise, Don Salvador's own business is not that successful: he has no employees, no machines, and merely uses his warehouse as a storage space. Besides, as he does not own a truck, he is dependent on buyers who are willing to drive to his warehouse to buy his materials. Yet, he knows the right buyers, he has the right contacts. He gained both his knowledge of plastic and his contacts when he was employed in the plastics industry. This is what led him to open a recycling shop, and this is what enables him to manage to at least make ends meet. Indeed, in each of the recycling shops I surveyed, I could identify an explicit strategy for gaining

[7] About six hundred dollars, which may have been half his wage (at best) or up to his entire wage.

knowledge. Most recycling shops owners were similar to Don Salvador: they had worked in the formal recycling industry beforehand and had kept contacts. This also means they know the "tricks of the trade" of processing. In two cases, the managers were merely employees, put there by a wholesale recycling buyer. Their job was to buy as much as possible of a particular material - but they did not have to worry about buying machines or trucks, processing the waste, or finding a buyer; the wholesaler would come as required a few times a week to remove all the material, and would pay the manager a fixed wage. In two other cases, the recycling shops had grown incrementally, and were set up by people who were waste-pickers and were trying to get a more stable and profitable activity. For instance, Doña Lucia used to be a waste-picker; but she did some construction work in order to save up and buy a truck. She now parks her truck in the street, takes out a floor scale on the pavement, and buys materials from other waste-pickers. Then, she goes and sells her truckload to the industrial area (survey 53, January 2016). This reflects how waste-pickers also learn through experimenting in their daily activities. The ones that fare better are the ones who experiment and learn the more efficient way of doing things. For instance, they may experiment with collecting only one or two types of materials, versus collecting all of them indiscriminately. They experiment with places, by trying to pick waste in different neighbourhoods or streets and learning which have the most potential, or at what time it is best to work. They experiment selling waste with different recycling shops, and learn about tricks being used against them (waste-pickers tell me stories of the scales being altered so that the weight comes out less than it really is) and which recycling shops are more prone to using them. They know where they can go to sell waste on a Sunday, at night, on bank holidays. Although most of their knowledge is learnt through experimenting, some of it is also shared by the recycling shops themselves, as Sofía does.

Acquiring knowledge. There are different kinds of knowledge that waste handlers use on a regular basis, and they are acquired in different ways. The first type of knowledge is experiential knowledge. Accessible to all, it is the knowledge that is the outcome of "learning by doing" and that can only belong to the person who worked to acquire it. Waste-pickers mostly rely on experiential knowledge to do their work, in this case, the knowledge is very localised (what is true of Tepito's streets may not hold in different neighbourhoods). Experiential knowledge is also used in the recycling shop, and is illustrated by Manuel calling himself an "everything-ologist". In both cases, knowledge is acquired through experimenting. Although it can be shared freely, this type of knowledge is not easily transferred as it is so localised: for instance, Manuel learns how to best process waste with the distinct specificities and constraints inherent to his own business. A different technique may well be used for the same process in a neighbouring recycling shop,

because of the skills, capacities and constraints of that other recycling shop. Thus, perhaps the most interesting aspect of this knowledge is the creativity and perseverance skills that those who engage in experimentation gain. As Sofia and Manuel explain to me, if their recycling shop fails, it would not be the end of their world. They are confident they would find something else they could do. They might even become tired of it at some point and choose to engage in a different activity. Most waste-pickers display the same flexibility and resilience in the face of their insecure situation. Most of them have different odd-jobs and know they do not only rely on waste handling to survive.

The other type of knowledge is what is generally called "expert knowledge"; it is the kind of knowledge that Manuel cannot access on his own, it is the reason he hired Martín as a consultant. Throughout my field activities (whether observations, surveys or interviews) the Perez's is the only place where I witnessed expert knowledge being used - all the other waste handlers I encountered relied exclusively on experiential knowledge. This knowledge is a lot less place- and time-specific - it is transferable in many ways, and thus it may be considered of higher value than experiential knowledge. Yet it is not easily shared, and experts have the monopoly of this knowledge, as Manuel found out. And thus, this knowledge can be used, but in a situation of dependence to the experts - Manuel depends on Martín to set up the machines, choosing the chemical mix and doing the different steps in the right order. Besides, the type of knowledge that Martín sells requires Manuel to invest in new machines and in chemicals: it is a long term, heavy investment, yet which brings the promise of higher profits.

7.3.3 Creating value from waste: the role of networks

Although not mentioned explicitly by interviewees as important to their work, relationships between actors appear to play an important role in how recycling takes place in Tepito.

Relationships of solidarity are the reason why some people engage in waste-handling altogether: the neighbours separating their waste for Luciano are an example. By separating their waste, they ensure that recyclable waste is not soiled with non recyclable waste. Thus, they ensure that Luciano's work is easier, cleaner, and more efficient. Interestingly, in Tepito, most households who separate their waste do it to sell the recyclables themselves, or to give it away to waste-pickers or building administrators. Throughout my fieldwork, and particularly when observing on the streets, I did not witness a single account of households separating their waste to ease the municipal team's work - they would always bring one single bag to the street, with all their waste mixed in it. It is known to all that the municipal team does engage in waste-picking as well - yet households do not separate their waste for them. But they do it for the waste-pickers. This may be explained by the fact that the municipal team earns a wage; while

the waste-pickers depend on this separated waste for their livelihoods. More generally, it relates to the feelings of solidarity felt in the neighbourhood which are used as a strategy to cope with poverty and marginality.

Another example of solidarity is that of the street sweepers towards waste-pickers. When they sweep the streets, they do not pick waste: for instance, they leave chunks of cardboard on the side of the road. When I asked Juan, a hired street sweeper who earns less than the minimum wage, why he and his team didn't pick up the cardboard to sell it; he told me "we already earn a wage; they [the waste-pickers] also need to work" (Wh5, October 2015). Sharing work among more people in order to share profits is a common practice in Tepito. Even the municipal team engages in it: the team regularly takes on board family members and friends in need of a job as voluntary helpers, and share their earnings with them.

The importance of solidarity networks in the survival of the urban poor has been described in great detail by Larissa Lomnitz in her book *Networks and Marginality* (Adler Lomnitz, 1977). Indeed, the relationships of solidarity that I document resemble her accounts. Lomnitz's focus was on the role of those networks for the life and well-being of the urban poor. In this discussion, I would like to explore this topic from a different perspective: rather than focusing on the impacts of these networks on the urban poor and their quality of life, I suggest that these networks contribute to Mexico City's waste management system. One further indication of this was in an interview with waste handlers who have worked both in Tepito and in upper-income neighbourhoods (where these solidarity networks tend to be less developed). These interviewees mention that there are a lot less waste-pickers in those neighbourhoods. As a result, the municipality team does engage more in waste-picking; yet, much of the recyclable waste is lost because it has been in contact with other waste which prevents it from being recycled (Mun8, October 2015).

7.4 Conclusions

This chapter has looked at the role of everyday practices in the management of recyclable waste. These practices and strategies are those which, ultimately, form the base for a healthy recycling industry. As the last chapter showed, informal waste handlers' work accounts for the management of over twenty percent of the total waste produced in Tepito, and ninety-nine percent of all recycling activities (the municipal team accounting for the remaining one percent). Thus, these practices shape a large share of Tepito's waste metabolism.

By describing the daily lives of non-governmental waste handlers, this chapter has put emphasis on the hard work required to transform waste materials into an input for the recycling

industry. It has also presented a glimpse of informal waste handlers' agency: informal waste handlers decide whether to engage in waste-picking, and how to engage in it. These decisions depend on many factors (among others, the prices of recyclables on international markets, how mixed is recyclable waste with other waste in bags, whether neighbours will help separate waste, and the willingness to earn money in a dignified way). Particularly, the decision of many households to separate waste not for the municipal team but only for waste-pickers, is an unexpected one, and is revealing of the agency of citizens and their reasons for engaging in waste management. It suggests the importance of solidarity networks in waste-handling activities. These networks are built over time: waste-picking is a routine activity, taking place daily within one neighbourhood, very locally. This plays a role in the strength of the solidarity networks and the sharing of knowledge.

In contrast, while I had expected to encounter a particular organisational system of waste handlers (that of *caciquism*), I was surprised once again. Neither the waste-pickers nor the recycling shops' owners talked about *cacique*-like relationships of hierarchical organisations; all but two were independent workers (and the remaining two were managers of recycling shops, hired by a recycling wholesaler). Rather than the top-down organisation that is generally thought of as being characteristic of informal waste handling, I observed workers with agency, developing strategies based on their own experimentation. Manuel's and Don Salvador's emphasis on the importance of experiential knowledge is but one example of the crucial role of knowledge and experiments in creating value out of recyclable waste.

One of the insights of this chapter is a reflection on the concept of informality, and how it applies in this context. The analysis shows that being registered as a formal business with the tax office, and complying with most regulations (the traditional definition of being formal or informal) is actually not determinant of how businesses are run. Indeed, there is no distinguishable difference between "formal" and "informal" businesses, when defined in this way (beyond paying taxes). The status of informality appears to be rather defined by an ongoing relationship with the government, where every aspect of the business can be negotiated, and where the business owner never has a secure, long-term right to work. I will explore, in the Discussion chapter of this thesis, how this relates to the institutional discourses identified in Section 5.1.

Chapter 8

Discussion

The purpose of this discussion is to identify how the empirical findings (Chapters 5-7) relate to the state of knowledge on the key topics of this research (Chapter 2). This chapter thus makes references to all the previous chapters, discussing their findings in an integrated way.

Some themes run through the discussion: first, the role of the informal economy in urban waste management is critically explored. Its relationship to formal systems and its sustainability impacts are discussed, which provides the base for more practical recommendations (such as the potential of formalisation) in the conclusion of this thesis.

Another theme is that of environmental justice: looking at the current and potential inclusion of informal workers in Mexico City's waste policy, this discussion reflects on the relationship between the concepts of urban sustainability and environmental justice, arguing that social equity, both in the distribution of environmental benefits and burdens, and in the political participation of different actors, is a concern that is relevant for both concepts.

This discussion is structured as follows: I start by discussing the concept of informality and what it means in the context of urban waste management. I then move on to answering the general research question: is the informal economy actually contributing positively to urban sustainability? Lastly, I discuss considerations of environmental justice.

8.1 Informality as the practices that *sustain* formal systems

In the discussion of the empirical data so far, the concept of "informality" (whether referring to the informal economy or more specifically informal workers) has not been critically approached; rather, it has been used descriptively to refer to a set of practices commonly known as informal. This set of practices has included, throughout the thesis, those waste management activities for which workers have no mandate or authorisation from the state to conduct. All companies handling domestic waste in Mexico City have to be registered with the Ministry of the Environment, and produce the required annual reports of environmental impacts monitor-

ing. The small recycling shops typically fail to comply with such regulations and therefore are commonly seen as "informal". This is a definition which is common in research on waste management and waste-pickers, such as in Ezeah et al.'s work, where informal waste work is defined as that which "lies out of state control" (Ezeah et al., 2013, p.2510). In this perspective, informality characterises activities not according to their type or way of functioning, but to their lack of compliance with regulatory frameworks. This is similar to how informality is understood from an economic perspective, as the following definition from Castells and Portes' seminal book shows: "[the informal economy is the sum of the activities that are] unregulated by the institutions of society, in a legal and social environment in which similar activities are regulated" (Castells and Portes, 1989, p.12). In this understanding, informality does not characterise a particular type of activities, but rather the lack of regulation of such activity. Castells and Portes' definition entails that the activities that make up the informal economy are similar to those of the formal economy. This means that informal activities could carry on unaltered if they were to be formalised. This assumption is therefore crucial to the possibility of a formalisation strategy.

Yet, this assumption of similarity between formal and informal economies has been challenged in urban studies. Particularly, Altrock calls for understanding informality and formality as "hybrid arrangements" (Altrock, 2012, p.188) where informal practices complement formal ones. He argues that informality develops as part of a hybrid formal-informal continuum, in settings not covered by formal institutions ("complementary action"), as well as in the areas where formal institutions fail to work properly ("supplementary action"). Research on urban waste management corroborates this perspective: Scheinberg et al. (2011) finds that informal activities do not only *compete* with formal activities; informal and formal activities also complement each other. The urban waste management system is therefore a "modernised mixture" of formal and informal practices (Scheinberg et al., 2011). In order to explore this possibility in the case of Tepito, it is necessary to move beyond a characterisation of informality, to exploring the relationship between informality and formality (McFarlane and Waibel, 2012).

Chapters 6 and 7 reveal the interdependencies of formal and informal practices. At first sight, it is difficult for an observer to identify formal and informal workers. The Perez family runs a business that they consider "formal" insofar as it is registered with the tax office. Their business is registered and their earnings are taxed, which is a general indication of formality. Yet, this business is indistinguishable from the neighbouring informal businesses. Although they choose to pay taxes, the Perez do not hire their employees on a legal basis (they work full time and with a regular income, but with no written contract). They are not registered with

the Ministry of the Environment, and do not comply with environmental regulations specific for waste management businesses. For instance, they do not produce an annual environmental impact monitoring, nor do they own the fire extinguishers required in the case of use of heavy machinery. In addition, the Perez suffer from extortion from civil authorities (see Section 7.2.4). All the recycling shops of Tepito are in similar conditions (they comply with some of, but not all of, regulations in place); although most do not pay taxes. Their characterisation as informal therefore depends more on one's specific definition of the term than on characteristics that are easily observable.

Within the municipal team, the dichotomy between formal and informal is also blurred. The voluntary helpers are informal workers which work alongside the municipal employees. They share the work of the municipal team, use the same uniforms, answer to the manager in the same way, and are paid by the municipal team. In order to be paid, they rely on informal cash flows (from *pre-pepena* and residents' tips) which are used both to sustain the informal workers, but also to repair the municipal trucks (again, blurring the boundary between formal and informal economies). As an observer, it took me a few weeks of observation and many questions asked in order to distinguish which members of the team were hired by the municipality and which were not.

At first, this observation may point towards an irrelevancy of the concept of informality - it may be more helpful to think of a waste management system where some formal rules are applied while others are not. Yet, a further analysis of the data shows that this would be a mistake: an in-depth exploration of this empirical case reveals that although informal and formal workers share the same spatio-temporal frame, they perform different tasks; rather than the compliance with regulations, it is those differentiated tasks which confirm the relevance of the characterisation. These tasks, or activities, are explored in Table 8.1.

The first line of the table analyses the role of the informal recycling chain (made-up of waste-pickers and recycling shops). It points out the lack of a formal alternative for the collection of recyclables: because this activity is not economically viable in the formal economy, instances remain marginal in Mexico City.[1] As such, informal workers provide a service which could not be provided formally, taking into account current market constraints. This activity provides the necessary input for the (formal) recycling industry. The activities of the informal recycling chain can hence be characterised as "complementary" to the formal economy.

[1]The Waste Inventory (SEDEMA, 2015) documents the main examples of formal collection of recyclables, among which the city's *recyclatron* (a government programme running monthly, where households can exchange their recyclables for locally grown food), and voluntary recycling plans of the private sector. This activities are so marginal that they are not quantified or taken into account in the waste management plan.

Table 8.1: Summary of instances of informal economy in Tepito's waste management, and their relationship with the formal system

Instances of informal economy	**Main activity**	**Purpose**	**Barriers to a formal alternative?**	**Characterisation of the relation to the formal system**	**Externalities**
Waste-pickers and recycling shops	Separate recyclable material from solid waste. Transform it into a viable input for the recycling industry.	Earn a livelihood	This activity is not economically viable when complying with regulations. There is currently no infrastructure in place to collect recyclables in a formal way.	Complement municipal activities. Provide necessary input to recycling industry.	Diversion from landfill, Social cohesion.
Voluntary helpers	1.Help the municipal team with overload of work in waste collection	Ensure the waste collection service is provided regularly and on time.	Not enough staff. Municipality does not provide sufficient resources.	Supplement municipal provision.	Provision of extra work for friends and families.
	2. Collect recyclables (*pre-pepena*)	Provide an extra earning to the team.	Not enough staff. Municipality does not provide sufficient resources.	Enhance capacity, complement municipal activities.	Diversion from landfill.
Informal earnings of the municipal team	Tips from local residents, and sales from *pre-pepena*	Pay voluntary helpers. Pay for truck repairs.	Municipality does not provide sufficient resources.	Supplement municipal resources.	
Street sweepers	Collect waste in market streets.	Replace municipal garbage-men in streets inaccessible to municipal trucks.	The municipal team would require alternative technical and human resources to collect waste in market streets.	Supplement municipal provision.	The quality of the service entirely depends on private street associations.

On the other hand, the following lines of Table 8.1 address aspects of the informal economy which support the municipal activity of waste collection. The voluntary helpers and the street sweepers (informal labour) and collecting tips and profits from *pre-pepena* (informal earnings) all contribute to the capacity of the municipal team to run the waste collection service. The research has shown that the municipal team would not function without this informal economy. Without informal tips and the sale of recyclables, the team would not be able to afford the maintenance of the trucks. Without the work of the voluntary helpers, waste collection in Tepito would not be done in the time allocated and waste would accumulate on the street corners. Without the street sweepers, whole streets would be left without a service collection, as the municipal service depends on trucks which cannot physically enter those streets. Therefore, these instances of informality are similar to those which Altrock (2012) describes as "supplementary" (taking over in the case of state failure), with the difference that this informal economy does not *replace* a governmental service as Altrock suggests; rather, they support its permanence.

Echoing the perspectives of Daniels (2004) (who argues that formal and informal economies are interdependent in contemporary mega-cities), and that of Grant and Oteng-Ababio (2012) and Scheinberg et al. (2011) (who both demonstrate that informal waste economies are integrated in local and global formal recycling trade networks, by supplying their main inputs), this analysis suggests that in the case of Tepito's waste management, the informal waste economy does not compete with its formal counterpart. Indeed, the activities carried out formally and informally are intrinsically different, and rather than competing, are interdependent. On the one hand, informal work and informal earnings supplement municipal waste management; that is to say that these practices address the municipal team's failure due to lack of resources. On the other hand, informal workers complement the formal waste management system by carrying out the recyclables collection and management, an activity which is beyond the duty of the municipal team. By doing so, they produce the key input of the formal recycling industry.

This analysis corroborates the perspective found in the literature that the formal and informal urban economies are interdependent. Yet, when trying to conceptualise how Tepito's informal waste economy relates to the formal waste management system, I suggest that not only are the two economies intertwined, they exist in what can be seen as a symbiosis. The idea of symbiosis refers to an interdependency between two entities which sustains at least one of

those entities (and may not be symmetrical).[2] Indeed, in this empirical case, both the formal recycling industry and the municipal waste collection service depend on informal practices. Therefore, informal practices *sustain* formal activities of waste collection, management and recycling.

This leads to an interrogation about the specificities of the informal system which make it more efficient than the formal one in this particular context: what is it about the informal economy which allows it to sustain formal processes? Although this is not part of answering the main research question (and was therefore not a focus of the research), the empirical data (in relation to the secondary literature) points to three main specificities, discussed in turn.

First, there is the flexibility of labour. In the informal economy, there are no contracts, no minimum wage, no social security. It is the flexibility of voluntary helpers (being hired for a day's work) which makes them ideal candidates to be called at the last minute to substitute a municipal worker who fails to show up to work. They also work with no guarantee on whether and how much they will be paid (as their pay will depend on the tips and the money earned through informal recycling on the day). Because informal workers are not paid a wage, they do not have the same commitment to the waste collection service. Rather, they take-up the labour-intensive tasks of waste separation and selection: voluntary helpers act as "extra hands" which can carry out the non-essential (but lucrative) task of waste separation for which the municipal employees have no time. On the other hand, the municipal employees have to give priority to street cleaning and waste collection as this is what they are paid for.

Informal waste-pickers provide a different example of flexibility. Waste-picking is an activity which can be taken up by anyone, without any prior experience, and with no particular requirement in terms of time investment. While some engage in waste-picking as a full-time, regular and permanent activity, many others take it up as a complement to other jobs. Some pick waste on the days that their employer does not require them, others work for a couple of hours in between two jobs. Waste-picking can also be combined with other chores, such as taking care of dependent relatives (such as Maria, who takes her grandchildren with her while waste-picking). In the recycling shops, some time-consuming processing activities are only carried out when employees have nothing else to do. For instance, when business is slow, Manuel asks his employees to extract the copper from old cables (an activity which is as lucrative as it

[2] Although the previous paragraphs have demonstrated the formal system's dependence on the informal economy, evidence shows that this dependence is not reciprocal. Various informal waste-handlers have demonstrated their low reliance on the waste business in order to survive. Many alternate between various jobs and are used to moving back and forth between sectors depending on which offers the best conditions at a given moment. This is exemplified by the Perez's confidence that they would be able to work in a different sector if their business failed (Chapter 7, see Section 7.3.2).

is time-consuming). These labour-intensive activities are made economically viable insofar as they are used to "fill" gaps in workers' days. This flexibility is not easily replicated within the formal economy, which generally requires the regular and exclusive employment of workers.

Second, urban informality is characterised by a culture of innovation (as has been noted in Chapter 2, see Harriss-White (2015) and McFarlane (2012b)). Informal workers are used to uncertainties as to their income, and therefore are more prone to experimenting with new activities or techniques without a certainty of success. It is therefore precisely the lack of codification which makes informality viable. The examples from the Perez are numerous: the employment of an engineer to help them with new techniques, Manuel's self-description as a *todologo*, and the shop's high capacity to adapt to the changing requirements of the formal recycling industry, all point towards a high adaptive capacity and innovation techniques which may not be as present in a formal business. Third, informality is characterised by the informal networks of self-help and solidarity already documented by Adler Lomnitz (1977) in the context of a suburban informal settlement. In Tepito's context, the solidarity networks appear to play an important role, not least in sharing knowledge and opportunities to work (helping waste-pickers engage in waste selection).

The empirical research has shown that informal activities can be understood as those which emerge in symbiosis to formal systems: they complement and support the formal system by filling those gaps where formal activities are not viable. In this understanding, informality does not only help to provide services to the poor, but is necessary to sustain the overall formal system, making use of flexibility, innovation and solidarity as key enablers. Indeed, seeing the lack of codification of informal practices as crucial to their role in sustaining formal systems is a perspective that has been documented in organisational studies (Friedberg, 1997) and sociology (Adler Lomnitz, 1988); in this literature, informality is defined as the processes that are not codified, yet necessary for companies and institutions to run. This understanding is radically different to that of Castells and Portes who argue that the productive activities of the informal economy are of a similar nature to those of the formal economy. A formalisation strategy is compatible with Castells and Portes' understanding of informality and may even be desirable; on the contrary, if informality is understood as the processes which sustain the formal economy, a formalisation strategy appears either counter-productive, or impossible to implement.

Arguing that informality is a necessity in any formal system does not imply that informality has to be accepted in a non-critical way. Roy (2015) warns against this utilitarian perspective on informality, where the potential benefits of informality for the capitalist system overshadow its dire impacts for informal workers. Indeed, necessity does not imply fairness or desirability.

Therefore, it is important that both its positive and negative impacts (in terms of sustainability as well as environmental justice) be highlighted and challenged. This is the topic of the next section.

8.2 The impacts of informal waste workers in urban sustainability

The research question posed in this research[3] entails documenting the contribution of informal workers to urban sustainability. This contribution can be expressed at different scales, from the neighbourhood to the city or global impacts. In addition, it is possible that informal waste management affects positively in certain aspects of urban sustainability (such as one of the four pillars: environment, society, economy or governance), and negatively in others - this is a result of having such an open-ended and inclusive definition of sustainability (justified in Chatper 2). The major aspects identified are discussed in turn.

Chapter 6 has documented the diverse roles of informal workers in Tepito's waste collection and management. Informal street sweepers evacuate the waste of market streets to where the municipal trucks can collect it. The municipal waste collection team relies on the work of "voluntary helpers" who are informal workers who help them along the route. The recycling chain, on the other hand, is made up of a range of informal workers (waste-pickers and recycling traders) who produce recyclable materials as an input for the (formal) recycling industry. One obvious impact of this participation is the diversion from landfill achieved by informal waste handlers. They manage twenty percent of the total domestic waste produced in Tepito, which is done through channelling recyclable materials to the recycling industry. Chapter 3 shows that the government currently achieves a nineteen percent rate of diversion from landfill (through composting and waste-to-energy programmes) – in Tepito, this achievement is outmatched by the informal waste handlers. There is a growing literature on the role of informal waste handlers in urban waste management systems: Wilson et al. (2009) suggest that between twenty and fifty percent recycling rates may be achieved in the informal sector, through separation at the source by households and waste-pickers. This finding is corroborated in the case of Tepito, as a twenty percent recycling rate is achieved at the collection stage (that is to say, this is excluding the recycling achieved by informal waste pickers on landfills). As recycling is a crucial part of diversion from landfill, it intrinsically has a positive impact on environmental protection. Yet, perhaps more importantly, research has suggested that recycling undertaken in the informal sector is less carbon-intensive than that of the formal sector: in a Life Cycle Assessment study of the case of Bogotá, Vergara et al. (2015) find that the current system of

[3] What is the contribution of the informal economy to waste management - and its sustainability impacts - in the neighbourhood of Tepito?

informal recycling emits less greenhouse gases per unit recycled, than any alternative scenario. The alternatives studied (prohibition of informal recycling, formalisation, or a hybrid system) would all entail an increase in greenhouse gases. Although this is the only study comparing the environmental impacts of formal and informal recycling, similar results have been found in other contexts: in a comparison of formal and informal settlements in Cape Town, Royden Turner (2012) has found that informal settlements promote a higher resource efficiency at the household level as they enable the (spatial and temporal) blending of productive and reproductive activities. Tepito's informal waste handling therefore appears to enhance Mexico City's resource efficiency through high recovery rates and a potentially low-carbon recycling process. Yet, a sustainability assessment must go beyond environmental impacts.

The case of Tepito shows that informal waste handling is labour-intensive and relies on the work of many local residents. The activity of waste-picking is a way to earn an income, either as a main activity or as a complement to other work. In his recycling shop, Manuel estimates that he buys waste from about two hundred local people, evenly divided between full-time waste-pickers, people who separate recyclables in their work (for instance, building cleaning staff) and housewives. His recycling shop (and the other eleven located in Tepito) therefore provide an extra income to a significant proportion of Tepito's ten thousand households.

The livelihoods that informal waste-picking enables are accessible and durable. They are accessible because any resident can engage in it: indeed, the empirical data showed how the disabled, the old, the carers, can all engage in waste-picking when they are not considered fit for a formal job. They can also be combined with a productive or reproductive activity (workers and housewives can use these activities to select recyclables), or act as a complement for people who are temporarily without a formal job. The livelihoods are also durable: all households and shops produce waste on a regular basis, which has to be disposed of. The activity does not depend on any input or investment external to the neighbourhood, and is therefore a durable way to earn a living. This is illustrated by the longevity of some of the waste-pickers interviewed in this research (over forty years of waste-picking in Tepito for some of them). Informal waste-picking thus provides livelihoods to the most marginalised populations in a durable way.

Chapter 7 showed how a strong reason for which many actors engage in waste separation is as a means to redistribute wealth. Households and local shop owners separate their recyclables and offer them to local waste-pickers, in order to help them make a living. The case of the Perez also shows that motivations to engage in the recyclables trade can go beyond mere financial concerns, as one of their key concerns is to have a business which enables them to re-distribute the added value to the local community. Furthermore, interviews with local informal waste-

pickers reveal that the recycling business provides them with more than money, but rather with the recognition that they contribute to their local community in a productive way. Rather than living off charity, they earn a living by providing a valuable service to the community. As such, the informal recycling chain plays a key role in the community's social cohesion and reduction of inequality and extreme poverty.

Informal waste management, appears to affect urban sustainability, both positively and negatively, at a range of scales: firstly, it contributes to diversion from landfill more carbon-efficient recycling processes. Considering Mexico City's political and environmental challenges associated with governing landfill sites (described in Chapter 3), this activity is particularly crucial for the whole city. These environmental impacts are felt beyond Tepito and on the long term: the diversion from landfill affects the metropolitan area of the city, while the reduction in greenhouse gas emission affects current and future generations beyond Mexico City. At the neighbourhood level, informal waste handling plays a key role in socio-economic development, through increasing social cohesion and the generation of durable livelihoods.

On the other hand, it is questionable whether Tepito's informal waste handling activities contribute positively to the governance pillar of sustainability. Governance for urban sustainability ought to be accountable and participatory. Tepito's informal waste management system, although not exploitative and autocratic as has been argued of informal governance system in previous research, is nevertheless not one that can be qualified as accountable or participatory. Informal waste handlers are denied participation in the policy-making process as they are not recognised as legitimate actors. Instances of corruption between waste workers and civil servants also question the accountability of the current governance system. This relationship between informal waste workers and civil servants is explored in the next section of this discussion, throug the lens of environmental justice.

8.3 The production of informality and implications for environmental justice

This discussion turns to the extent to which informal waste management follows principles of environmental justice (fair distribution of environmental goods and bads, recognition of experiences of those affected by environmental processes and inclusive participation in political processes) (Schlosberg, 2004). So far, informality has been looked at in terms of its benefits for the overall waste management system (and urban sustainability). Yet, there is evidence that not only is the informal status of informal workers unfair (as it maintains them in a situation of vulnerability), it is also produced.

As highlighted in the literature review, Yiftachel (2009) and Roy (2009) argue that rather than being an intrinsic quality of certain urban processes, informality is produced by the government as a "governmental tool" (McFarlane and Waibel, 2012, p.4), that is to say, as a way to reproduce the existing balance of power. Labelling certain actors as "informal" is a way to strip them of their legitimacy and therefore to maintain them excluded from decision-making processes. Indeed, this resonates with my research. The portrayal of informality by civil servants (described at length in Chapter 5) is different from (and, I would argue, in opposition to) the description of informality as sustaining formal processes. Within civil servants' discourses around urban sustainability, informality is systematically dismissed as a barrier to modernity and development. Civil servants in charge of urban sustainability policies, for instance, overwhelmingly use a discourse of green growth. This means that they conceptualise urban sustainability as an objective which can be achieved through investments in clean technologies and a promotion of the role of the private sector. In this understanding, urban sustainability is defined as a city with low environmental impacts (low pollution and resource efficiency). Within this agenda, there is little room for the integration of informal workers.

This focus on investment in technology and infrastructure is not atypical for an urban government, and indeed, it can be explained by institutional settings. In Mexico City, the Ministry of the Environment and the Ministry of Urban services are co-jointly in charge of waste management. Yet, they are also in charge of the reduction of environmental pollution (particularly GHG emissions). Their work is assessed based on their performance in this respect. Thus, when proposing policies and projects, civil servants are induced to propose quantified targets which focus on resource efficiency and the reduction of GHG emissions. The agenda of green growth is well suited to these concerns. On the other hand, there is no incentive nor capacities for these two ministries to tackle issues of social justice or the prosperity of local livelihoods as part of the policies they put forward; as discussed in Chapter 5, their lack of concern for informal workers may partly be explained by their inability to act.

Informal workers, feeling their livelihoods threatened, may be resistant to the green growth agenda. Indeed, the investments in new technologies and private-public partnerships are aiming to address gaps in the waste management infrastructure, directly competing with informal work. One example that interviewees mentioned is that of the construction of Mexico City's Bus Rapid Transit, which was faced with resistance from organised groups of (formal and informal) bus drivers. In order to overcome the resistance, civil servants produce a discourse of informality as incompatible with a democratic, modern society. Rather than opposing informal workers to green growth, they oppose them to democracy, progress, order and development. It

thus becomes easier to dismiss their role and exclude them from the decision-making process. Although the analysis presented here corroborates this view of informality as produced by the state, a minority of interviews presented an alternative: two civil servants adopted what I have labelled a "pragmatic" approach to informality, treating groups of informal workers as any other local residents. They both had first-hand examples of successful collaboration between informal workers and the state in an effort to achieve sustainability objectives. These accounts provide us with evidence that the government's attitude of exclusion of informal workers is not a necessary one, and that within this system, alternative paths to inclusion can be found. Nevertheless, they remain anecdotal.

Chapter 7 has explored the implications of this discourse for informal waste workers: by being categorised as illegitimate actors, informal waste handlers are pushed into a state of precariousness and vulnerability. Both the voluntary helpers and the waste-pickers carry out dangerous work, resulting from direct contact with waste (syringes, nappies, glass...) and the animals feeding on it (cockroaches, rats, stray dogs) without the appropriate protection (gloves). The voluntary helpers are also at risk on the municipal trucks, with accidents taking place regularly. As one interview revealed (interview 33, Section 5.2.2), decision-makers are aware of this situation but refuse to be held accountable for the risks associated with informal work. In addition to physical health risks, waste-pickers and voluntary helpers have no job security and no fixed income.

As Yiftachel (2009) has argued, the government uses discourse to de-legitimise particular informal groups, and therefore to re-produce particular urban inequalities. The fact that these hazards are not documented and remain invisible to the public makes it easier for both policy-makers and the formal recycling industry to hide the exploitation that is inherent in the current system. Indeed, previous research on the state and sustainability of the waste management system of Mexico City omitted the role of informal workers. This has two main implications: on the one hand, the risks taken by informal workers were undocumented, which prevents a discussion as to how to mitigate those risks (and the role of the government in such an effort). On the other hand, refusing to characterise informal workers as legitimate stakeholders in waste management by documenting their contribution to the system deprives them of the legitimacy which is necessary for them to gain representation at the decision-making table. Both these implications of informal workers' invisibility pose questions of environmental justice, as the contribution to environmental management is made at the expense of workers' health and recognition.

I hope to have demonstrated in this thesis that the inclusion of the informal economy in knowledge production (research) and decision-making (policy) for urban waste management is not only fully justified on moral grounds, but it is also necessary in order to bring about a more sustainable urban system. Informal workers are currently being treated in an unfair way, as their contribution to managing waste is not being recognised and they are denied a voice in political processes. Their inclusion is therefore justified on ethical grounds. In addition, this inclusion is also made essential on practical grounds: informal workers play an essential role in the waste management system by participating in a diversity of activities. This participation remains largely undocumented. If policy-makers are to improve the waste management system, they have to be able to understand how it works, who is involved, and what practices work and which do not. Unless a particular effort is made to include these marginalised actors in urban environmental management studies, sustainability assessments will remain partial, threatening efforts towards urban sustainability. Therefore, the agendas of urban sustainability and environmental justice appear to converge in this empirical case. The improvement of the working conditions of waste workers is related to both the social pillar of sustainability and the distributional component of environmental justice. The call for the recognition and inclusion of workers in decision-making relates to both the governance pillar of sustainability and the recognition component of environmental justice. Lastly, the reduction of environmental impacts associated with waste disposal achieved by the informal waste workers contributes to improving the environmental pillar of sustainability and to reduce the environmental burdens for later generations, a key aspect of environmental justice.

Chapter 9

Conclusion

In the prologue of this thesis, I presented two interrogations which pushed me to conduct this research. The first interrogation was a practical one (how do informal processes contribute to urban sustainability?); the previous chapter discussed how the findings of the thesis address this interrogation. The second interrogation, methodological in nature (how to make better datasets for urban environmental policy-making?), is what I choose to reflect on in this conclusion.

The conclusion is structured in the following way. The first section reflects on the main findings of this thesis by answering the three research questions. Then, implications for practice and research are discussed, looking first at informality and waste management, and then at everyday practices and urban sustainability. The chapter ends by opening up avenues for further research.

9.1 Summary of research findings

This thesis has explored the daily realities of waste management in a neighbourhood of Mexico City. This empirical work enables the research questions presented in Chapter 4 to be answered.

- How does waste flow through the neighbourhood of Tepito?

Chapter 6 has documented the flows of domestic waste emerging from the neighbourhood of Tepito. The municipal team of garbage-men plays a key role by collecting domestic waste and transporting it to the municipal transfer centre. The municipal team is made up of truck drivers, pawns, street sweepers and a manager. Their work is supported by the informal economy, through the work of informal workers (informal street sweepers and voluntary helpers) as well as through the earnings of informal income (the sale of the *pre-pepena* and the tips from local residents). In parallel, waste-pickers and recycling shop workers build up the informal recycling chain, by extracting recyclable materials and transforming them into a viable input for the recycling industry.

- Which socio-political and physical factors organise these waste flows?

Tepito's configuration of waste flows is shaped by a range of factors. Firstly, waste management is shaped by the production of policies at the Mexico City level. The prohibition for municipalities to negotiate concessions with the private sector for waste collection, and the compulsory separation of organic and non-organic waste, are examples of rules that the municipal urban services division has to apply. At the municipal level, it seems to be the lack of resources (or its unequal distribution between neighbourhoods, as suggested in Chapter 5) which determines the quality of the waste management service. In Tepito, the resources are so scarce that there is no *toque de campana*, the usual practice to collect domestic waste in the city. These planning constraints are not specific to Tepito, and therefore explain the relative homogeneity of waste collection services throughout the municipality (and beyond). Yet, the waste metabolism cannot only be explained by the planning processes which govern it. Indeed, a close look at the specificities of Tepito reveals how other factors shape the configuration of waste flows. One such factor is the built environment and the use that is made of it: the exclusive use of some streets of Tepito by informal markets, for instance, constrains the municipal collection service by rendering the streets inaccessible to the trucks. This requires a manual collection of domestic waste, which explains Tepito's reliance on informal street sweepers. Tepito's social organisation around informal street leaders proves instrumental in designing this solution to the problem of the inaccessible streets.

Yet, physical and institutional factors (planning processes) are limited in explaining the complexities of Tepito's waste metabolism, unless they are explored in relation to local socio-political dynamics. The lack of *toque de campana* enables the activity of waste-picking, but this activity can be explained more directly by the poverty in Tepito, and the need for many people to gain access to a livelihood.

The difficulties of the municipal team find their origins in the lack of municipal resources, yet they are greatly exacerbated by the conflictive relationship between the residents and the local government. It is this relationship of antagonism which can explain the residents' reluctance to dispose of their waste at the appropriate time and place, and to dispose of it in bags and well-separated.

Culturally, this historical conflict with the government has contributed to developing strong community ties between local residents, which can help explain the complex organisation of waste-picking activities. Chapter 7 shows how waste-pickers rely on solidarity networks, that is to say, their neighbours separate their recyclable materials for them, which makes their work more efficient and safer.

Likewise, the work of recycling shops does not depend only on the density and spatial configuration of the neighbourhood, but also on the social cohesion among waste-pickers and recycling traders, which allows for experiential knowledge to be transferred widely, enhancing the productivity of all workers (particularly in knowing which materials to select and how) and therefore making the activity viable.

The exploration of the case of Tepito reveals how waste management is a socio-technical landscape, where technologies and the physical layout of the built environment intersect with social and political dynamics, producing a particular configuration of waste flows.

- What are the consequence of these waste flows for sustainability and environmental justice?

Tepito's informal economy has been shown to contribute to the city's overall sustainability, yet the treatment of informal workers is not just nor inclusive.

The informal recycling chain achieves a twenty percent rate of diversion from landfill, thus contributing to the city's resource efficiency and lowering the environmental impacts associated with landfilling. In addition, the profits of recycling activities are shared among all workers, which include the most marginalised groups of this low-income neighbourhood. In this sense, informal recycling contributes to the socio-economic sustainability of the neighbourhood. Yet, Chapter 2 has argued that urban sustainability must take into account issues of resource distribution and participation of the stakeholders in the policy process, if the sustainability achieved is to be fair and inclusive. In the case of Tepito's waste metabolism, this is yet to be achieved. Chapter 7 has shown that informal workers suffer from risks associated with their jobs (not least the physical risks related to putting one's hand through trash with no gloves). This level of risk is maintained by their lack of legitimacy at the institutional level. Civil servants refuse to publicly acknowledge the role of these informal workers in the waste management system, acknowledgement which would be a pre-requisite to a potential technical support from the government. Indeed, informal workers remain invisible in official datasets, and have no say in decision-making processes for the future of Mexico City's waste management.

The results of this research challenge a traditional understanding of sustainability as separate from concerns of equity, and more widely environmental justice: how can a system be labelled "sustainable" if it depends on workers risking their own health and livelihoods in order to sustain it? In the light of Tepito's case, it is necessary to reclaim the concept of "urban sustainability" and to frame it as the state of a city which not only has low environmental impacts, but also which has a fair distribution of environmental benefits and burdens across citizens, and

which recognises all workers as legitimate stakeholders. If environmental justice is a key aspect of sustainability, then both governmental and academic research need to document sustainability beyond the environmental impacts of a system.

9.2 Informality in waste management research and policy

This thesis calls for a systematic inclusion of informal work in waste management studies. There is still a long way to go, particularly in the case of Mexico City. The discourse analysis presented in Chapter 5 reveals civil servants' awareness of the existence of informal waste workers, yet a profound misunderstanding about their status, role and contribution to the system. The implementation of the sustainability agenda (which, in Mexico City's waste management policy, amounts to the investment in waste recovery technologies) is enabled by a discourse which relies on a rhetoric of violence and exploitation: many civil servants associate informal workers with a mafia, an ungovernable group which exploits its workers in an autocratic way – this is given as the main reason for refusing to include them in the decision-making process. This discourse can be traced back to the scarce literature on informal waste handling in the Mexican context. Mainly, this is the research by Castillo Berthier (1984) in one landfill, which was groundbreaking in its in-depth exploration of the *cacique* system ruling the groups of informal waste-pickers living on landfills. I do not deny that this was, and still is, a reality. Yet, the empirical findings of this thesis question whether this reality is relevant to the case of contemporary informal waste-pickers and recycling traders working outside of landfills. The great majority of the waste handlers I interviewed are independent workers (with the exception of two recycling business worker who are employed by a larger company). They emphasise the liberty they have in their work, and I could not identify instances of exploitation or violence. This suggests that it is urgent to document more recent and plural accounts of the organisational system of informal waste workers. The narrative of informality as an exploitative mafia has to be revisited, and should not be used as an *a priori* characterisation of any informal work, nor a justification for refusing to engage with informal waste handlers in policy-making.

Informal work forms part of urban waste management systems; this needs to be recognised and taken into account in research. This case has been made by researchers who have documented the role of informal work in urban waste management (Scheinberg, 2012; Scheinberg and Anschütz, 2006; Wilson et al., 2009). Yet, the inclusion of informal processes in waste management databases is not a call for their automatic formalisation. Although civil servants are quick to argue that informal work, being technically illegal, cannot be included in policies unless it is formalised, the findings from this research question this argument and call for an

innovative answer to this dilemma. If the informal economy *sustains* the formal system, then a formalisation strategy would put at risk the formal system itself. Therefore, the documentation of informal practices must be systematised in order to produce a more sophisticated understanding of how formal and informal systems relate, and how this symbiosis can be enhanced in order to improve urban sustainability. This does not require formalisation: the examples of civil servants who collaborate with informal workers on sustainability projects (Chapter 5), and successful cases documented in the literature (see particularly the work of Scheinberg and Anschütz (2006)), show that a collaboration between civil servants and informal workers can take many forms, and can take place without the pre-condition of formalisation. Documenting informal workers' contribution and acknowledging their legitimacy as key partners is, however, a necessary first step.

9.3 Sustainability research

There is a case to be made for documenting informal workers' role in urban service provision. But an emphasis on environmental justice is not the only reason to include "people" (widely defined) in environmental research. The other reason put forward is the crucial role of everyday practices in urban environmental management. The empirical chapters of this research provide an in-depth understanding of waste workers' everyday practices, and how they influence the waste management system. Waste handlers (whether formal or informal) demonstrate agency in their action. This agency cannot always be assumed – it is at times unexpected and surprising. For instance, municipal workers change their working hours and practices to avoid conflict with residents. The Perez choose to locate their recycling shop not in the most profitable neighbourhood, but in the neighbourhood where they grew up and where they know they can serve a community purpose (redistribute the wealth created from waste to local people). Even local residents choose not to separate domestic waste when it is for the municipal team (which is a legal obligation), but they choose to do it on a voluntary basis when they know it can help a waste-picker in need. Thus, engaging in waste handling cannot always be explained by monetary reasons – solidarity plays an equally important role in the neighbourhood of Tepito. In addition, the practices of local actors are co-dependent, as waste recycling emerges as a community activity which could not be undertaken by a single actor on its own. Here, the spatial configuration of the neighbourhood as well as the social networks that exist within it play a role in enabling the collective engagement with waste management.

These examples have helped answer the second research question (Which socio-political and physical factors organise these waste flows?). Understanding the agency of local actors

(why they choose to act how they do) is necessary in order to produce effective policies. For instance, the Cuauhtemoc municipality is currently running a campaign for better waste separation. This campaign is based on a song and some ads running on TV and the radio, and posted on the local street walls, explaining to residents how to better separate. The main assumption of this campaign is that residents do not know that they have to separate, and how to do it. This campaign will only be successful if this assumption is correct. Yet, the findings of this research show that, at least in the case of Tepito, a lack of awareness is not the main factor explaining residents' reluctance to separate organic from non-organic waste. Rather, residents choose not to separate their waste for the garbage-men because of their long term conflict with local authorities. Based on this example, I would argue that understanding agency is crucial in the successful design of policies to enhance the waste management system, perhaps more important even than a quantification of flows. Civil servants have tried for years to improve the rate of domestic waste separation of households. Currently, this rate of separation is still low throughout the city (below fifty percent) and education campaigns prove ineffective. In tackling this issue, documenting the decision-making process of households may prove more helpful than a quantification of flows and separation rates. For instance, knowing that solidarity is an important factor in Tepito, policy-makers could replace the education campaigns by schemes organising the collection of local residents' separated waste by local informal waste-pickers.

What is important about this example is that it goes beyond the topic of informality. Everyday practices play a role in urban sustainability, even in a formal context. Sustainability research therefore has to provide the space and methods to integrate considerations of everyday practices and local dynamics as part of a diagnostic of the city's sustainability, whether in the global North or South, in formal or informal contexts. If we want to understand the configuration of urban resource flows, we have to look at everyday management in order to understand the values, practices and strategies that shape the city's metabolism.

Conducting the research presented in this thesis entailed designing an innovative methodological approach to address this challenge. A traditional Material Flows Analysis would not allow for an exploration of the everyday practices of waste workers. In addition, it does not challenge the invisibility of some stakeholders, nor does it provide an understanding of social impacts of material flows. Thus, a traditional MFA is not an adequate tool (on its own) to explore urban sustainability. In this thesis, the alternative approach that is proposed entails using MFA as a data-gathering tool, which can be used to explore, with a range of stakeholders, the multiple and diverse experiences of waste management co-constructing the city's waste metabolism.

Using an ethnography and a localised case-study was a requirement to gain such depth in the data. It required spending time doing exploratory work, observations, to gain people's trust, and understand what questions to ask. The observations undertaken with the Perez provide in-depth information that could not be achieved through other means. Such in-depth information only represents what happens in one shop. The survey and interviews conducted in the other local recycling shops allowed me to contrast the information gathered with the Perez, and to see which aspects are similar or different in other businesses. Particularly, it showed how although all the recycling shops have a particular strategy for accessing knowledge, the Perez's is the most extreme, as it implied paying a consultant to acquire expert knowledge. This example shows the value of mixed-methods, to not only gain in-depth data but also triangulate it. I hope that this thesis, by presenting this methodological approach, its main findings and its limitations, has contributed to the call for re-orienting urban sustainability research to include everyday practices.

9.4 Avenues for further research

This work has shed light on how waste collection and management take place in Mexico City, and with what sustainability impacts. Yet, there are still many unknowns about the waste management system, which should be studied in further research. With regard to the role of the informal economy in waste management, further research needs to be undertaken to determine its environmental impacts (particularly on toxic emissions associated with processing waste). This is a topic which is pointed out as crucial in the literature (Brown et al., 2014; Benson, 2014), yet which is under-researched (Vergara et al. (2015) being one exception).

Another gap with regard to the waste management system is that of the role of the private sector. Very little is known about Mexico's formal recycling industry. The environmental impacts of such industry are not documented, nor is its relationship to the informal economy. Similarly, the role of the private sector in waste collection is not documented - we have yet to learn about the recycling and waste disposal practices of these companies. Although the role of the private sector in waste collection may not be relevant to lower-income neighbourhoods such as Tepito, it may be more relevant to the case of upper-income neighbourhoods: gated communities in particular, tend to provide services in a way which is different to other neighbourhoods of the city, relying more heavily on the private sector, as has been documented in the case of Santiago de Chile (Guibrunet et al., 2016). Yet, researching the private sector may require different research methods than those presented in this thesis.

On the other hand, the research methods presented in this thesis address the need to document everyday practices in relation to urban sustainability. This opens up many avenues for research, beyond the narrow case of informality in waste management. Researchers have argued that we need to understand informality better: Neuwirth (2013) calls for more research to be conducted on the relationship between informal and formal actors of cities, and how their work can help lead a more socially equitable development. McFarlane (2012b) argues for including the informal city in research on urban entrepreneurialism. This is true for waste management and beyond: for instance, Mexico City's food metabolism would be a fascinating case. Duhau and Giglia (2007) have documented how a rise in the formality of the food system (by the increase in number of supermarkets) does not lead to less, but more informality (in the form of food vending in street stalls), and that informal food vending practices appear to galvanise, complement and sustain formal food vending. This dynamism of the informal food metabolism calls for further research into the role of the informal economy in contemporary cities' metabolism.

I would argue that this thesis suggests an avenue for thinking about this issue in an innovative way. The informal workers presented in this thesis have been dismissed by those in power as low-skilled workers forming part of a pre-modern economy, yet I would argue otherwise. Indeed, their skills and experiences might be an asset in the inevitable transition towards a technology-intensive world. In the case of Tepito, the flexibility, ingenuity, solidarity and innovation spirit of informal workers actively contribute to supporting the formal waste management system and the (highly technological) recycling industry. This shows that the informal economy, by being labour-intensive, can be adaptive and resilient, particularly in a fast-changing environment. In this light, informal workers can play a key role in enhancing the adaptive capacities of modern technological systems.

It seems overly narrow-minded to refuse to consider the contribution that they currently make, and in turn to imagine the role they may make in the future. With the challenges ahead, we cannot afford to waste such an asset. This calls for further research, particularly in the organisation of formal-informal systems, as well as in the fair inclusion of informal workers in environmental governance. This research will contribute to a fairer, more inclusive transition towards a modern and sustainable society.

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Appendices

Appendix A

Glossary of Mexican Spanish terms

- **cacique**: Native American title for a chief or leader. This term has been used to describe political leaders in contemporary Latin America. In an urban context, a cacique is an individual exercising an exclusive influence in local politics, who is the only mediator between a given group of workers and the state, and who may exert an autocratic, informal and violent power.
- **chachara**: A trinket, an object of little value.
- **pepena**: Mexican Spanish term for waste-picking. Comes from the indigenous Nahuatl language "to pick up".
- **pepenador**: Mexican Spanish term for a waste-picker.
- **pre-pepena**: term used by civil servants in Mexico City to refer to waste-picking which takes place on the municipal collection truck (during the transport from the Municipal Transfer Centre to the Waste Selection Plant).[1]
- **todologo**: Literally "everything-ologist". This term is sometimes (though not always) used in a derogatory way, to refer to people who think they are an expert in everything.
- **toque de campana**: Literally "bell-ringing". Refers to the municipal waste collection service where the collection trucks drives slowly through residential streets, at a relatively similar time daily, and rings a loud bell to call out households, who come out with their refuse and hand it directly to the municipal team.

[1] It is identified as "pre" because it takes place *before* the subsequent waste-picking activities on the waste selection plant and on landfills. Yet, it is problematic as it suggests (by omission) that these are the main activities of waste-picking, and therefore excluding the waste-picking which occurs in homes and on the street, before the waste is even collected by the municipal services.

Appendix B

Interview guide for civils servants and experts

- Introduction
  - Presentation of thesis topic
  - Explanation of the interview process
  - Asking for consent to participate
  - First question: Description of job in relation to the topic at hand
- Informality in Mexico City
  - The informal economy
  - Contribution of the informal economy to the urban economy
  - Contribution of the informal economy to the city's environmental management, and to sustainability
  - Public policies which address this issue
  - Who are key actors who participate in decision-making in this context?
  - How do formal and informal actors relate to each other? For instance, how to they work together in the provision of urban services?
- The case of Tepito
  - How is Tepito different or similar to other neighbourhoods in Mexico City?
  - Why is Tepito an interesting case?
  - How does the informal economy shape Tepito's economy and environmental management?
  - Who are key actors who participate in decision-making in Tepito?
  - How do formal and informal actors work together in Tepito?

- Closing questions
  - Which would be, according to you, a crucial public policy to improve urban sustainability / service provision / environmental management [as appropriate] in Mexico City?
  - What would be the role of informal actors in this policy?
  - Is there anything you would like to add?

Appendix C

Information sheet for participants

You will be given a copy of this information sheet. Please discuss the information below with the researcher if there is anything that is not clear or if you would like more information. It is up to you to decide whether to take part in the interview or not. If you do decide to take part you are still free to withdraw at any time and without giving a reason.

All data will be collected and stored in accordance with both the Mexican Federal Law for Protection of Personal Data in Possession of Private Parties, and the United Kingdom Data Protection Act 1998.

Who is conducting the research?

Louise Guibrunet, research student in University College London, England [Institute for Sustainable Resources, 14 Upper Woburn Place, London WC1H 0NN, England], is the researcher collecting your data. The person responsible for the use and protection of your personal data is the researcher's supervisor, Prof Paul Ekins [Director, Institute for Sustainable Resources, 14 Upper Woburn Place, London WC1H 0NN, England].

What is the study about?

The study is called "The urban metabolism of the informal economy – Case study of Tepito, Mexico City". It researches the governance of environmental processes in the context of informality, and in particular water and energy use, and waste management. The objective is to document the contribution of the neighbourhood of Tepito to Mexico City in terms of environmental management and sustainability.

What personal data will be collected?

The researcher will conduct interviews with street vendors, informal workers and leaders of street associations. These interviews will collect data on water and energy use, and waste generation, especially in relation to day to day activities. Besides, it will collect data on potential

links to a commerce association, and political activities in relation to water, energy and waste management.

How will the data be collected?

The data will be collected through one to one interviews between participants and the researcher. Written notes will be taken if explicit consent is given by the participant. Interviews will be recorded only if explicit consent is given by the participant. Recorded interviews will be transcribed and the tape will then be wiped clear.

How will your personal data be used and protected?

Your data will not be shared with anyone, and will be anonymised. This means that your name will not be stored in the same files as your personal data; and both files will be password protected. The researcher will not share your data with anyone including other participants in the study.

Once the data is anonymised and results are analysed, findings will be written down as a thesis that will be available to participants upon request. Findings might also be published as academic journal papers, although drafts would be shared with all concerned participants for review, and consent would be asked. Findings will only be published if concerned participants give their consent.

If you do not want your personal data to be used, it is your right to refuse to participate in the interview. During the interview it is your right to refuse to answer any question.

After the interview, you can also change your mind at any time and decide you want your personal data to be deleted. In this case you can simply contact the researcher who will delete all your personal data.

After completion of the research (estimate date of december 2017), your personal data will be deleted.

How can you access, modify, delete your personal data?

You can contact the researcher, Louise Guibrunet, to ask for your personal data to be amended or deleted at any time, as well as to ask for further information on the research.

<u>Contact details:</u>

Phone number in Mexico: [deleted from this version of the document]
Phone number in England: [deleted from this version of the document]
Personal email: [deleted from this version of the document]

Institutional email: [deleted from this version of the document]
Postal address: [deleted from this version of the document]

This study has been approved by the UCL Research Ethics Committee (Project ID Number): 6158/001

Appendix D

Survey questionnaire directed at managers of small recycling shops

1. The first visit
    - Date and time (observed)
    - GIS location and address (observed)
    - Size of the premises (observed)
    - Who is in charge of this business?
    - Would you be willing to take part in a survey?
    - When should I come back? When is a quiet day for you?
2. The survey
    - Date and time (observed)
    - Are you the owner? What is your role here?
    - How long have you worked here?
    - How long has this establishment been opened?
    - How many people work here? Are they men or women?
    - What kind of materials do you buy?
    - In which quantity do you buy each of these materials?
    - Who are your suppliers (households, waste-pickers, workers...)? In which proportion?
    - How many suppliers would you trade with on a normal day?
    - In what quantities do you buy (that is to say, by the gram, kilo, or tens of kilos)?

- What machines do you have here to process the materials?
- What do you use these machines for?
- Do you own any vehicles (pick-up trucks, car, trucks)? How many?
- Who are your buyers? Are they part of the recycling industry, or are they intermediaries?
- How far do you travel to sell your material?
- Do your buyers provide receipts?
- Have you had any contact with government offices about your work? If so, which one?
- Is this a regular contact?
- Do you have a license to work? Who gave it to you?
- Have you ever received some sort of training by the government? What kind?
- How did you learn the "tricks of the trade"?
- How did you find your buyers?
- How could your work be improved, or eased?
- What is the biggest challenge in your work?
- Which materials don't you buy? Why not?
- Do you benefit from any sort of social services (could be health services, pension scheme, holiday pay, etc)?
- Do you have anything to add?

Appendix E

Survey questionnaire directed at waste collection truck drivers

- What is your name?
- Which truck do you drive?
- What is the daily route of this truck?
- Can you describe me the activities of a normal working day?
- Do you have helpers on your truck?
- Do you (or somebody in your team) separate recyclable materials from the waste you collect?
- How much weight does this amount to, approximately, in a week?
- Where is this material sold, and by whom?
- How (with what resources) do you provide maintenance to your truck?

Appendix F

Publications of the research

- Guibrunet, Sanzana Calvet and Castán Broto (2016) 'Flows, system boundaries and the politics of urban metabolism: Waste management in Mexico City and Santiago de Chile' in *Geoforum*, vol. 85, pp.353-367
- Guibrunet and Castán Broto (2016) 'Towards an urban metabolic analysis of the informal city' in Archer and Bezdecny (eds.) *Handbook of Cities and the Environment*, Cheltenham: Edward Elgar Publishing, chapter 7, pp.160-180